SOIL AND WATER CONSERVATION

TO ADVANCE THE WISE USE OF SOIL AND WATER

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National Inventory of Conservation Needs

Part Two New Plant Materials

Drainage Related to Fertilizer Use

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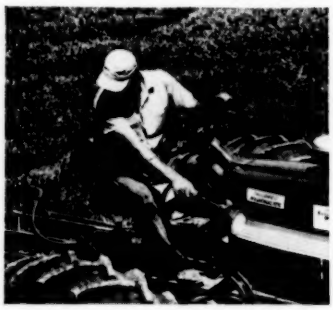

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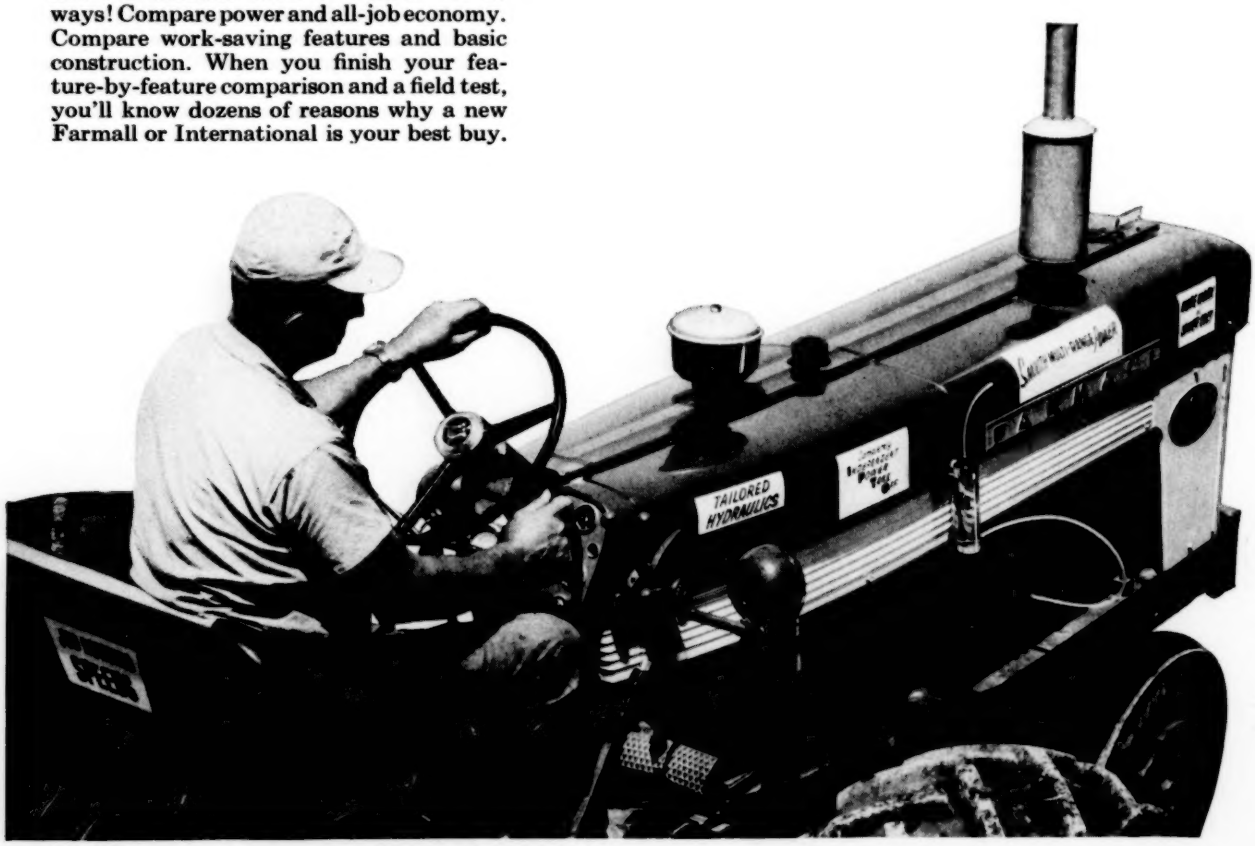

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TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE

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Foresters in the Santa Fe National Forest check watershed conditions on the Hamilton Mesa in the Pecos Wilderness Area.

United States Forest Service Photo

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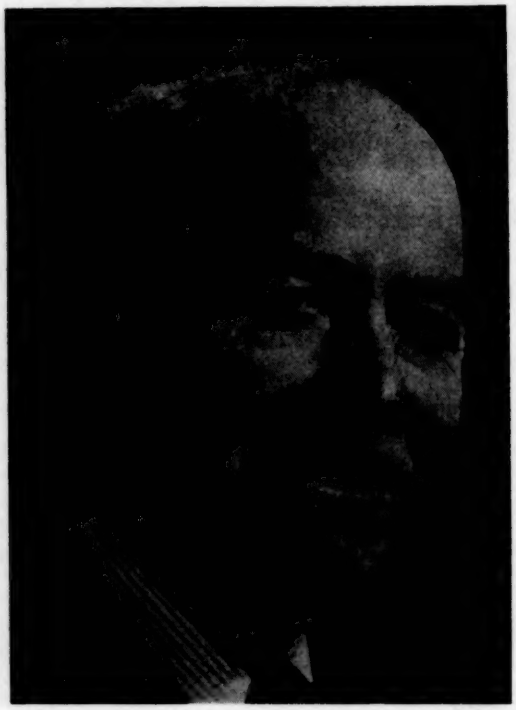

Nearly seventy years ago the young boy Hugh Hammond Bennett stood in the mud of a North Carolina field and watched his father build a small bank across the slope.

"You do that to hold the soil," he remarked.

"Yes, son. It helps some to stop the gullies."

The boy looked around, up and down the hilly worn out farm.

"Gullies, yes, there they are. We can make more banks."

When his life ended, last July 7, the man Hugh Hammond Bennett had to his credit the stopping of uncounted millions of gullies, design and fabric for a clean and cared for rural landscape in his own beloved country and fanning out over the world, and a shining pattern for leadership and vision regarding use and conservation of our only true heritage, our soils.

We are now reminded of the slow early years of his struggle for recognition of the land problem as he saw it so vividly. For long there was doubt as to whether the people would ever catch the real picture of their rapidly declining agricultural base. We see him, a young man, stalking the hills and valleys for soil samples, erosion causes, production figures, people suffering for need of good ground in which to grow their food. For the true and convincing story of soil ruin and waste he searched the land itself, while out of his own conviction grew his remarkable capacity for instilling his faith and conviction in others.

Once the way was cleared and he was permitted to speak out, the driving force of his campaigning for soil conservation was so compelling as to be unique in agricultural history. When in his prime and as we first knew him well, it early became apparent that he would succeed in awakening Americans to the dangers of continuing waste of the land resource. In assembly halls across the Nation, country people and town people alike, alert to his every word, testified to the success of his grassroots awakening. This man loved the land of America. He had an affinity for the soil, the waters, and all that grew therefrom. He had the rare quality we can only call perception for things and trends not seen by most, and he truly loved America. And he was so human his listeners forgot that he was a noted scientist.

Later, after he had performed that near heroic feat of creating a new science—soil and water conservation—and had organized a new kind of government agency to cope with waste of soil, then did we see the practical side of the man. He had a dream but he was no dreamer. In a matter of weeks, he brought men of many sciences together to build the Soil Conservation Service. He sent his technicians into the field to start the biggest face-lifting job in history. He was called the one-idea scientist, but his idea had many facets. Classify and use the land according to its capabilities, plan the farms for complete conservation, acre by acre, to give farmers something to work by, manage the water and the soil as one, never relax vigilance in using the soil the conservation way—these are but a few of the principles he wove into a science of conservation for the land.

With amazing foresight he looked always into the future while he spread lasting conservation use and treatments over the land. Alert always to anything that might threaten the permanency and soundness of soil conservation for his country, he met it with hard facts and feet planted firmly on the ground.

Hugh Hammond Bennett was the founder of the Soil Conservation Society of America. It was part of his dream, along with an ever productive and beautiful landscape. We take great pride in our founder, in the honors heaped upon him while he lived, in his ineradicable imprint on our lives and our land. We shall miss him from our ranks.

—Phoebe Harrison

New Resource Planning Data from the National Inventory of Conservation Needs

HENRY W. DILL, JR., AND KENNETH C. NOBE

The National Inventory of Soil and Water Conservation Needs is nearing completion. It will provide a new source of information on present land use by soil type, slope and degree of erosion on a uniform basis for the entire country.

The primary reason for collecting this information on a nation wide scale was to provide an overall estimate of the kinds and amounts of soil and water conservation measures needed in the future. These data and the sample plots on an aerial photograph base can also be used for detailed studies of many other agricultural phenomena related to land use and soil characteristics.

This article discusses the history of the National Conservation Needs Inventory, describes the unique features of the data obtained, reports results of special studies which made use of the Inventory data, and indicates additional potential uses of these data in agricultural research.

UNDER A DIRECTIVE from the Secretary of Agriculture work on the National Inventory of Conservation Needs was begun in 1957 (1). Eight agencies of the Department of Agriculture, cooperating under the leadership of the Soil Conservation Service, were directed to carry out the Inventory within a 3-year period beginning January 1, 1957.[1] The Secretary further directed that the Inventory, summarized by individual counties, be kept current after its initial development.

Soil survey and land use data on a nationwide basis were an important prerequisite to carrying out the Inventory. By January 1, 1957, the Soil Conservation Service had finished standard soil surveys for millions of acres of land as part of its regular activities. It was apparent, however, that completion of soil survey activities at this level of detail for the remaining unmapped areas during the specified time period was impossible because of shortages of both funds and trained personnel. Consequently, a decision was made by the Soil Conservation Service to obtain estimates of nationwide land use and soil condition by use of probability sampling methods. Cooperative agreements were entered into with the Biometrics Unit at Cornell University and the Statistical Laboratory at Iowa State University to design and construct the necessary land area sampling system. The Biometrics Unit at Cornell selected the samples for the 13 northeastern States and the Statistical Laboratory at Iowa State University selected the samples for the remaining States (including the new States of Alaska and Hawaii) and Puerto Rico.

A basic area sampling rate of 2 percent was determined to be statistically reliable at the county level (2). Two separate sets of 2-percent samples were selected so that if necessary the sampling rate could be increased to 4 precent. The following procedure was used in selecting sampling units: Each county was divided into blocks (strata), which were further subdivided into either 48 (at Iowa State) or 49 (at Cornell) substrata of equal size. One sample unit was selected at random from each substrata for each of the two sets of samples. The size of the sample area varied from 40 to 160 acres. For most of the country the sample unit was 160 acres. In the 13 northeastern states a unit of 100 acres was used. The 40-acre unit was used in special situations, but sufficient numbers were taken to provide the equivalent of the 2-percent standard. The two sets of samples were identified by (a) and (b) subscripts. The (a) samples were used for the initial 2-percent sampling rate. Details of the sampling procedure are described in reports by H. L Taylor (3) and J. E. Doud (2).

The sample plots were identified on individual county maps. These maps were sent to each State, where Soil Conservation Service personnel transferred the sample plot boundaries to an airphoto base for field mapping and measurement of data (figure 1).

The following land use classes were mapped: (1) cropland, (2) pasture and range, (3) forest and woodland, (4) other land (farmsteads, idle agricultural land, wild-

[1]The cooperating agencies operating under the leadership of the Soil Conservation Service are the Agricultural Conservation Program Service, Agricultural Marketing Service, Agricultural Research Service, Commodity Stabilization Service, Farmers Home Administration, Federal Extension Service, and Forest Service.

Mr. Dill is an agriculturist, in charge of the airphoto analysis work in the Land and Water Research Branch, Agricultural Research Service, U. S. Dept. of Agriculture.

Dr. Nobe is an agricultural land economist with the Agricultural Research Service, U. S. Dept. of Agriculture.

life areas, and other open-country land not used for agricultural purposes), and (5) urban and built-up areas. Soil type, slope, and erosion data were also mapped on the sample plots. In many instances, detailed soil mapping data were available and were transferred to the sample plots, but up-to-date land use was mapped in the field. Land capability was determined from the assembled soil-survey data.

The next step consisted of measuring and tabulating the acreage of each combination of land use with soil type, slope, erosion, and land use capability. A separate plot summary sheet was prepared for each sample and forwarded to one of several designated statistical laboratories for rapid data machine processing. Data from these summary sheets have been transferred to punch cards in most of the States and completion of this job in the remaining States is underway. The sample plot data were initially expanded to county summaries by rapid data computing machines. Total acreage estimates by land use, soil type, slope, erosion, and land capability were made. Once this step was completed for some areas, various combinations of these data were possible; they were subsequently used for the various special studies described in the following sections of this paper.

Summaries of these data for each county were provided for special county conservation needs committees, composed of USDA, State, and local agency representatives, farmers, and others who prepared estimates of land use and conservation needs to 1975. County estimates are completed but State and national review activities are still underway.

Unique Characteristics of the Inventory Data

The major advantage of the Inventory data over similar data from other sources is its adaptability to meet the special basic data needs for various kinds of political and geographic area studies. Compilations of the Inventory data that will be made will depend upon the various purposes for which the data are used. The first summaries are being made on a county and State basis in order to meet the prime objective of the Inventory, that is, to provide physical data as a basis for estimating nationwide future needs for soil and water conservation measures (4).

In addition, however, recording these basic soil survey and Inventory data on punch cards will permit the preparation of special tabulations by natural divisions such as land resource units and areas, soil conservation districts, watersheds, river basins, agricultural regions, and other area divisions that can be located by boundaries on a map.

In many instances, more exact information can be obtained on some item included in the Inventory data by resorting to other sources, but so far as the authors are aware, there is no other source from which all the various items available in the Inventory can be obtained in such a way that they can be correlated with one another within given geographic areas; certainly, they

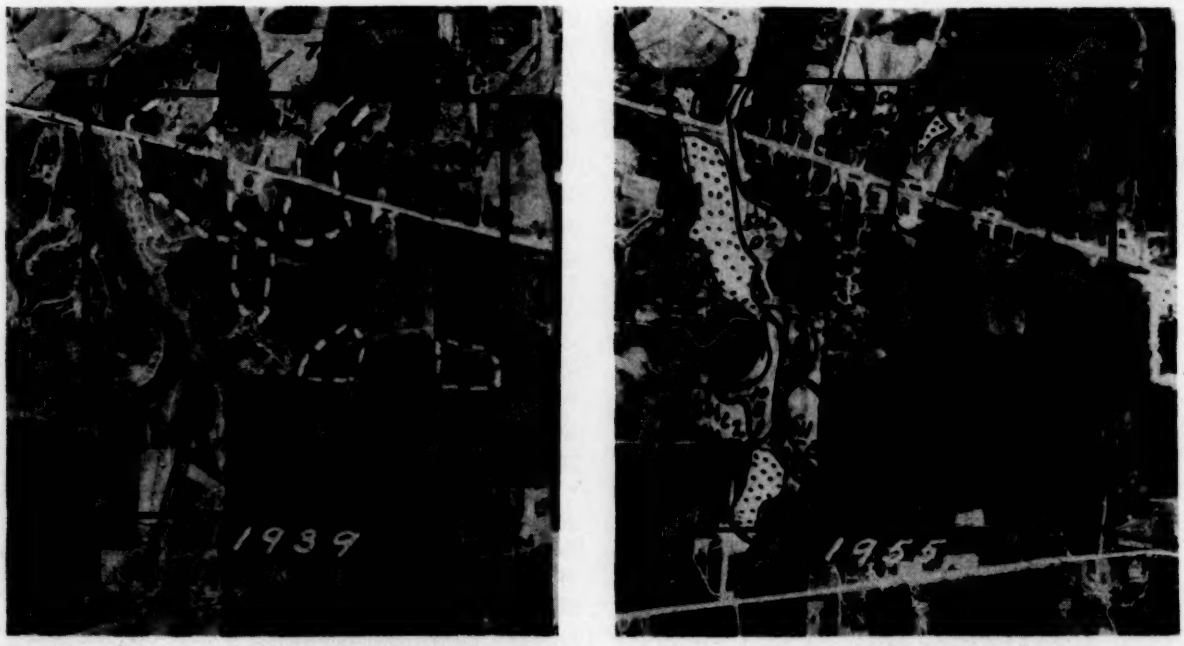

Figure 1. A typical National Inventory sample plot in Alamance County, North Carolina, is shown in the 1955 airphoto on the right. Soil type, slope, and erosion are indicated by symbols. Land use is shown by letters. The dotted areas are constructed ponds. Changes in land use from 1939 to 1955 are indicated on the 1939 airphoto of the sample plot area.

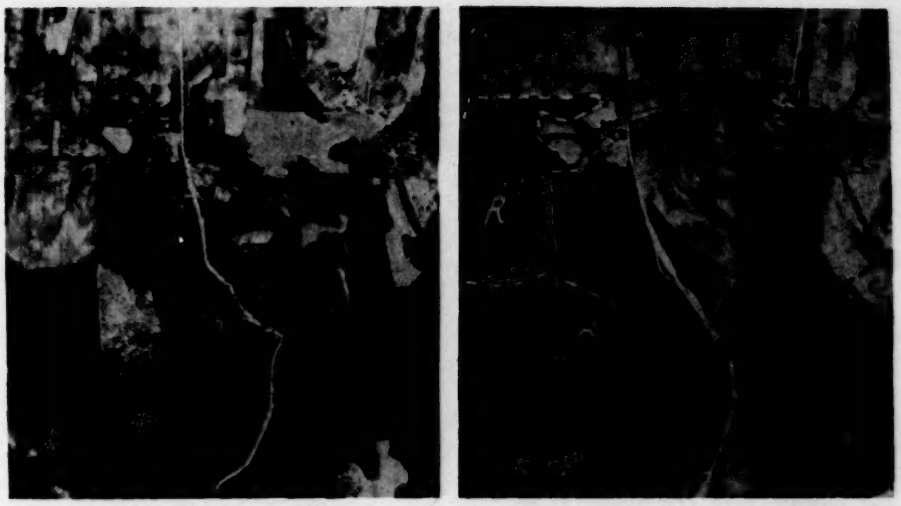

Figure 2. Reversion of farmland to forest (R) and clearing of forest land for farming (C) are shown in the airphoto on the right, taken in Guilford County, N. C., in 1955. Changes in land use are indicated by comparison with the 1937 airphoto of the same area shown on the left. Scale 1:20,000.

Commodity Stabilization Service, U.S.D.A., Photo

are not available on a State or nationwide basis.

Many special summaries of physical data may be obtained from the Inventory data. For example, estimates of acreages of cropland by soil types or acreages of major land use by land capability classes are easily obtained by using a rapid data processing machine to analyze the appropriate sample cards.

Estimates obtained from the Inventory samples are statistically reliable with a maximum of 20 percent standard error for study areas that meet the minimum area restrictions of 400,000 acres (2). Use of the sample data for smaller areas will carry a greater percentage of error, but nonetheless in many instances, the degree of associated error would probably be less than the unknown standard error associated with some other source of data. In the past, apportioning land use and condition characteristics of natural geographic areas (watersheds, river basins, etc.) from data that has been summarized by political subdivisions has been difficult, expensive, and subject to the possibility of considerable error. Now that the Inventory data is available on punch cards, however, compilation of such data for various resource studies can be accomplished with a minimum expenditure of time and funds.

The adaptability of the Inventory data to meet the requirements of geographic study areas that do not conform to political boundaries has been demonstrated. A special summary of data from Inventory sample plots lying within the Potomac River Basin was prepared to provide basic physical data for a Federal Potomac River Basin Survey currently underway. A total of 96 tables, summarizing various combinations of land use, land capability, and soil type, slope, and erosion data were obtained for the various physical and political subdivisions in the basin. These data were obtained for an overall cost of $3,000. An approximation of the same volume of physical data from other sources would have involved at least 2 man-years of work and an expenditure of more than $50,000. Because the sample plots are recorded on an airphoto base, the plots themselves become a useful tool in some types of land use studies.

Special Studies Reported

A number of special studies, based on information from the Inventory, have been completed by personnel in the Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture. These studies include analysis of land use conversion, determination of economic trends and of the recreation potential, and the use of Inventory data as the basic source of physical land use and soil condition information in a river basin survey.

Land Use Conversion

Data from the sample plot summary sheets in combination with data obtained by airphoto analysis of the sample areas are a useful tool in land use conversion studies. Since the Inventory sample plots are located on airphotos, they can be used in conjunction with earlier photographic coverage of the sample plot areas to establish land use trends by airphoto analysis and/or field analysis to collect additional data.

Prior to development of the Inventory, need for physical land use data in several agricultural research fields had prompted the development of a procedure for obtaining such information by airphoto comparison analysis (5). In this procedure, airphotos taken at different times are studied to determine the rate and degree of change in land use, such as cropland development by clearing forest land or drainage, reversion of cropland to pasture, forest or idle land, and shifts of agricultural land to urban, industrial, and other nonfarm uses.

Although much necessary information can be obtained by this method, it is difficult to correlate such data with soil type and land use capability.

Modifications in the procedure by incorporating the Inventory sample plot mapping were developed in a land use conversion study in the Cape Fear Basin in North Carolina. Measurements of changes in land use during the period of study provided data for refining previously available estimates of land use conversion. Table 1 demonstrates the type of information that can be obtained by using airphoto comparison analysis of the Inventory sample plots and earlier photographic coverage for this purpose (figure 1). Table 1 shows that conversions from cropland to forest and pasture over and above those that would have been recommended on the basis of land use capability classes alone have taken place. It is further noted that some forest land has been converted to cropland by clearing and draining. On the basis of the land capability classification, these changes have not occurred on the areas classified as suitable for the new use. For example, Capability Classes II and III (recommended for cropland with a minimum of conservation practices needed) have reverted to forest in some instances because reversion of farmland usually takes place by whole farm units.

TABLE 1
Changes in Land Use by Land Capability Classes, 1938-55[1], Alamance County, North Carolina.

Land capability class	*Land use 1938*[2]	Land Use Changes to 1955				
		Cropland	*Pasture*	*Forest*	*Other*[3]	*Urban*
LCC[4]	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
	Cropland					
I	1,256					
II	43,937		196	1,804	1,587	2,172
III	24,971		334	2,541	128	90
IV	8,454		622	2,852	109	714
VI	96		—	—	—	—
VII	723		—	3,311	—	—
	79,437		1,152	10,508	1,824	2,976
	Pasture					
I	73					
II	9,023			146		144
III	10,378			—		334
IV	8,150			—		622
VI	74			—		—
VII	2,302			98		—
	30,000			244		1,100
	Forest					
I	48					
II	28,864	7,209				547
III	38,042	6,128				274
IV	39,644	2,728				—
VI	6,671	—				—
VII	18,831	1,647				91
	132,100	17,712				912
	Other					
I	39					
II	5,890					
III	4,619					
IV	3,000					
VI	—					
VII	2,425					
	15,973					
Total	257,510	17,712	1,152	10,752	1,824	4,988

[1] Determined from airphoto comparison analysis of sample plots selected for the National Inventory of Soil and Water Conservation Needs. Changes include land clearing, reversion of farmland to woodland, and shift of farmland to urban and residential use.

[2] Estimated by adjustment of preliminary county totals from the national Inventory.

[3] Includes areas previously in cropland that have a bushy cover and are apparently in process of transition to forest.

[4] Land capability classes.

Shifts of agricultural and forest lands to urban and industrial uses is an additional type of land use change to be considered in projections of future conditions. Sample plot data provide statistically reliable estimates of acreages that historically have been involved. The use of these data in conjunction with data obtained by airphoto analysis of older photographs of the sample areas provides a base upon which future land use trends can be estimated.

Other Economic Trends

Other indications of economic activity can sometimes be obtained by use of the Inventory sample plots. Airphoto analysis of the plots comparing older and more recent photographs may provide data on changes in type of farming, such as shift from intensive cultivation to grassland, dryland to irrigation, etc. Figure 4 illustrates the shift of intensive cultivation to grassland farming. Comparison analysis of the plots may also show change in field size, changes in types and numbers of buildings, and other factors that can be correlated with location, land use, and soil condition.

Changes in type of farming and field size were obtained in the Upper Cape Fear Basin study to supplement land use conversion estimates and other information on distribution of soil-complexes.

Potential Recreation Site Studies

An airphoto analysis method to estimate kinds and numbers of potential recreation sites, based on the Inventory sample plots, has been developed and tested in a study of Hampshire County, West Virginia. Major consideration in the study was given to locating and evaluating potential usefulness of several classes of recreational sites, as well as their accessibility by existing road networks.

Five classes of sites were selected for study and summarized by three classes of access. The type of data

TABLE 2
Summary of Data from NICN Recreation Sites Study, Samples Obtained from Airphoto Analysis, Hampshire County, West Virginia[1].

Location of site	*Type of site*				
	Head waters	*Steep stream*	*Valley pond*	*Forested slope*	*Stream frontage*
	Number	*Number*	*Number*	*Number*	*Number*
Forest:					
Distance from highway:					
On	1	3	2[2]	4[3]	2
1,000 feet	1	2	1	—	1
Distance from farm road:					
1 mile	5	2	1	2	1
2 miles	1	—	—	—	—
Other:					
3 miles to any road	1	1	—	—	—
Pasture:					
Distance from highway:					
On	1	—	7[2]	—	2
1,000 feet	—	—	1	—	1
Distance from farm road:					
1 mile	2[2]	1	4	—	1[4]
2 miles	—	—	1	—	—
Idle:					
Distance from farm road:					
1 mile	—	—	2	—	1

[1]Site data shown are for the sample acreage before projection to obtain county totals. Total sample acrage 5,500 acres distributed: cropland 1,093, pastur 383, forest 3,656, idle 323, farmstead 45.
[2]Pond already constructed.
[3]Girl Scout Camp area in operation in one of four sites on this sample.
[4]Fly-in site, possible 2,000 foot grass landing strip.

obtained is shown in table 2. With this kind of basic data, it is possible to estimate the number of sites by type and degree of access for the study area under consideration. For example, if 10 steep valley stream recreational sites under forest cover are found on a sample of a given area and total forest land in the sample amounts to 3,000 acres, the estimate of the expansion factor for this type of site would be 1 for each 300 acres of forest land. Such an expansion factor can be determined and applied to compiled Inventory data for counties or other designated study areas.

Basic Data Source for Comprehensive River Basin Surveys

As a result of the success obtained in using Inventory data on a limited scale in the Cape Fear study, the Inventory was chosen as the major source of basic physical data in the agricultural phase of the Potomac River Basin Survey.[2]

The savings in time, personnel, and funds (not to mention the likelihood of increased acuracy of the results obtained) have been mentioned. Perhaps of equal value is the fact that the use of these data will provide *all* cooperating agencies with the same land base figures. The importance of data in this form is expressed as follows in the *Instruction Manual for Potomac River Basin Tables of Agricultural Data Estimates* (6).

"The 96 tables included in these five volumes were compiled to provide basic agricultural data for a wide range of study items under consideration in the Potomac River Basin Survey. These tables provide the most recent and unbiased information available on land use and soil conditions for the Basin as a whole. The major advantage of data in these tables over data from Census and other secondary sources is that they are based on a random sample of all whole and partial political subdivisions included in the Basin. Such estimates are more reliable than using proportionate percentages of Census and other data summarized by political subdivisions.

[2] The Corps of Engineers has been authorized by the Congress to prepare a plan for the development and conservation of water and related resources in the Potomac River Basin. A number of Federal, State, and other public agencies are cooperating in this survey. Three agencies of the U. S. Department of Agriculture—The Soil Conservation, Forest, and Agricultural Research Services—are responsible for the study of the agricultural aspects of the survey.

Figure 3. Shift of farmland to industrial use is shown in Bucks County, Pa. The airphoto on the right was taken in 1958. The same area on the left was photographed in 1950. Scale 1:20,000.

Commodity Stabilization Service, U.S.D.A., Photo

TABLE 3
Estimated Proportion of Land Use by Capability Classes, Physio-Economic Region V, Potomac River Basin, 1958[1]

Capability class	Distribution of land use by capability classes: Cropland		Pasture		Forest		Other[2]		Total land by capability classes	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
I	—	—	—	—	334	100.0	—	—	334	0.2
II	7,247	26.7	1,958	7.2	10,346	38.1	7,604	28.0	27,155	11.5
III	10,527	28.3	2,913	7.8	14,358	38.7	9,382	25.2	37,180	15.8
IV	1,950	13.2	618	4.2	8,456	57.0	3,797	25.6	14,821	6.3
VI	1,776	2.9	3,105	5.1	41,933	69.5	13,563	22.5	60,377	25.6
VII	911	1.0	2,616	2.7	67,792	70.8	24,390	25.5	95,709	40.6
VIII	—	—	—	—	27	27.6	71	72.4	98	(3)
Total	22,411	9.5	11,210	4.8	143,246	60.8	58,807	24.9	235,674	100.0

[1] Excludes water. [2] "Other" includes all land that is not specifically used for production of crops, pasture or forest—it would include idle, urban industrial, roads, etc. [3] Less than 0.05 percent.

Adoption of these estimates by the various agencies engaged in the Survey insures uniformity of results among selected phases of the study undertaken by individual agencies."

Table 3 shows one type of analysis based on Inventory data that is being carried out in the agricultural phase of the Potomac Survey.

In resource development planning efforts, such as the Potomac Survey, comparison between present conditions and those expected at some future dates, with and without the project, are needed in order to determine cost-benefit ratios on suggested works of improvement.

Conclusions

The National Inventory of Soil and Water Conservation Needs provides researchers, planners, and technicians with the most comprehensive and up-to-date compilation of land use and soil condition data available today. The primary purpose of the Inventory is to provide a basis for estimating the magnitude of the future soil and water conservation program needed. For several reasons, the Inventory data are useful tools also in other land area research and development efforts. Among these reasons are:

- The Inventory provides the most uniform and recent data on land use related to land capability and soil conditions available on a local area, county, State, and nationwide basis.
- The Inventory sample plots are recorded on an airphoto base and thereby allow the association of individual factor data or combinations of factor data with specific location.
- Data are summarized on punch cards and can be processed to provide estimates of land use and soil condition in many kinds of geographic areas under study—whether or not they conform to political boundary lines.

Although it is not yet completed, apparently the Inventory will fulfill its major objective. It has already made significant contributions to resource planning.

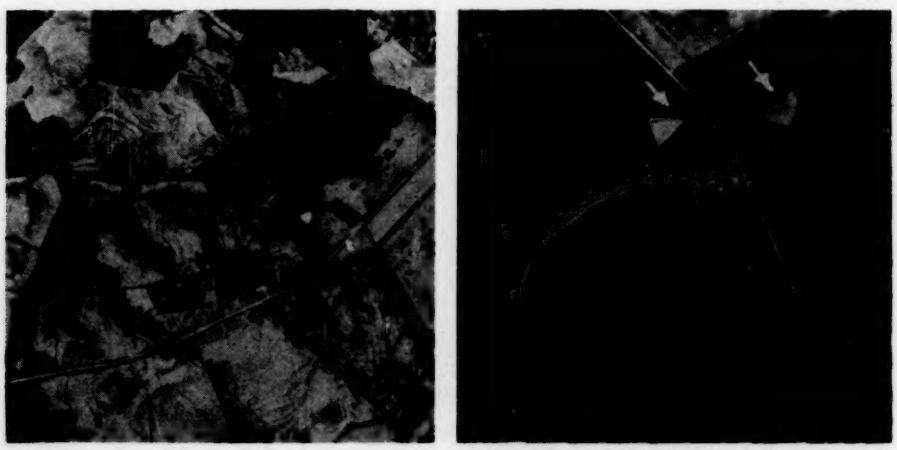

Figure 4. Change in type of farming in Guilford County, N. C. Intensive cultivation in 1951, shown in the airphoto on the left, has changed to grassland farming in the 1955 photograph of the same area shown on the right. The white arrows on the 1955 photograph point to farm ponds constructed since 1951.

Commodity Stabilization Service, U.S.D.A., Photo

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Introduction of New Plant Materials In the Corn Belt States, Part Two

KENNETH WELTON

The first part of this article in the July issue of the JOURNAL traced the early work of the Soil Conservation Service nurseries and their successors, the plant materials centers. Methods of getting adapted new plant materials established in the field were described.

The second part of the article chronicles specific plant materials being studied and their adaptations in the field.

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PASTURE IMPROVEMENT, sod waterway, wildlife habitat improvement, and bank and gully stabilization projects are common to all nine Cornbelt States. Other projects are also described in which plant materials for specific purposes are being developed.

The need for a legume that will persist under a practical and economic pasture-management program on blue-grass in the Cornbelt is a problem of long standing. A legume is required that will remain, even if it must be temporarily mismanaged or neglected, but which will respond to fertilizer and grazing management and provide additional forage should the farmer need it. Such a legume should be productive during mid-summer when bluegrass commonly is non-productive.

Work with the Empire strain of birdsfoot trefoil has confirmed early indications of its value. It persists under close grazing, remains vegetative (even under drought conditions), has a tendency to thicken and improve with age under intelligent management, and is non-bloat producing (10) (13).

Difficulty in establishing this legume in the Cornbelt has delayed its acceptance, but with recommended cultural techniques, many farmers have maintained excellent stands for as long as twenty years and are well satisfied with it. More than 200 field-size plantings have been made in soil conservation districts since 1955. Evaluation has progressed to the point that birdsfoot trefoil is included in the technical recommendations of both the experiment stations and Soil Conservation Service for use under certain conditions in four Cornbelt States. Indications are that birdsfoot trefoil will, in time, be one of the more valuable contributions to the pasture economy of the Cornbelt.

Sod Waterway Improvement

The establishment of a good sod is routine on gradual slopes with good soil as long as the farmers construct, prepare seed beds, fertilize, use seed mixtures, and manage them as recommended. However, in every state extreme site conditions are found where the problem of moving surface water without causing damage must be solved.

In the search for better plants or combinations of plants, some of the important factors that have to be considered are: Will the plant grow and serve the purpose intended on the problem site? Can the plant be grown from seed or does it require the more expensive vegetative planting? Do the physical characteristics of the seed make it difficult to plant? Does the plant require special seed bed preparation? Should it be seeded with a companion crop, and if so, what crop may be used that will not be too competitive? The need for protection from cattle, mulching, soil amendments, and heavy applications of fertilizers must be considered.

The two plants presently used in waterways were introduced by Soil Conservation Service nurseries, but they are not entirely satisfactory under extreme conditions. Reed canarygrass forms good sod, but its habit of forming a dense matted sod in wet ditches causes siltation to the point of filling the channel. Tall fescue persists with less attention than many other grasses under poor and droughty soil conditions, once a stand is obtained; but a thin stand may not improve under such conditions, and the resulting thin, bunchy turf will not prevent erosion.

Improvements over these plants were desired and promising results have been apparent from plantings of switchgrass and creeping foxtail *(Alopecurus arundinaceus)* (4). The creeping foxtail gets away to an early start in the spring, even under cold, wet conditions. It spreads slowly by rhizomes but does not have the disadvantages of Reed canarygrass. Switchgrass will persist and produce under lower nitrogen levels than many introduced grasses and because it will also spread by

Figure 6. A four year old crownvetch planting from seed gives excellent bank protection in Indiana.

rhizomes is superior to tall fescue under certain conditions. Even a poor stand of both these grasses will usually develop into a dense sod. Evaluations have already shown that the Blackwell strain of switchgrass is still the best strain available from commercial sources for practically all Cornbelt conditions. Seed of true creeping foxtail is not yet readily available on the market.

Wildlife Habitat Improvement

Multiflora rose plantings in the Cornbelt have probably done as much to improve wildlife cover as all other plantings made for that purpose. Food production and cover are limited by winter freeze back as we go north in the Great Lakes region. Although strains of multiflora rose have not been found that can be depended upon to escape winter injury under severe conditions, one strain of multiflora and a cross with Rugosa rose (introduced from northern China and similar to multiflora) shows more recovery vigor than the multiflora rose now available.

Biologists indicate that with development of suitable protective cover, odd areas (unused, rough, eroded, or out-of-the-way places) can become heavily populated by wildlife, especially when located near corn, small grain, and other crop fields. Plantings of lespedezas and native grasses produce a good wildlife cover when protected from livestock. The geographic and site adaptability of switchgrass, Canada wildrye, and Indiangrass with either sericea or shrub lespedezas are being studied.

Other work on this project with the biologists includes the improvement of duck and goose pasture with grasses and legumes. As a result of a planting at the game farm at Hillsdale, Michigan, where Canadian geese are confined, field brome (*Bromus arvensis*) has replaced other grasses because of its wearing qualities and supply of palatable forage at the proper season. Field brome is supplying early spring grazing attractive to ducks and geese wherever planted for this purpose in the Lake states.

There is also the ever present search for plants that will insure a continuing emergency food supply for game, especially during the months when agricultural crops are not available. A large number of trees, shrubs, legumes, and grasses were suggested many years ago by Soil Conservation Service biologists to guide this work. Although many species are available to the public and are being used in large quantities, others, perhaps even more valuable, are available only as relatively costly ornamentals. Some of these have been selected for increase at the plant materials centers for extensive field plantings to gain information about their range of adaptability, while biologists continue to study their wildlife values.

Bank and Gully Stabilization

The common problem of stabilizing drainage ditches or gully areas involves many factors, such as, steep slopes, erosion, seepy conditions, drought, low fertility, and competition with weeds. Tall fescue on poor soils

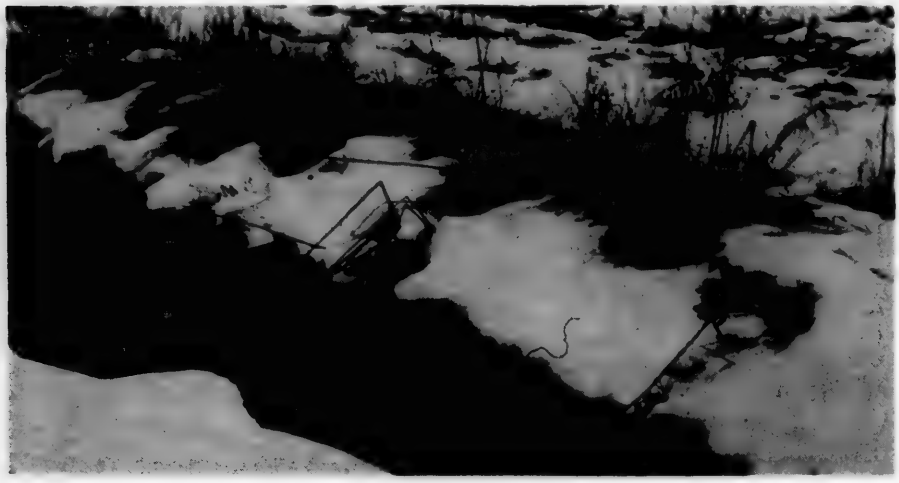

Figure 7. In one year creeping bentgrass has completely stabilized this Michigan ditchbank. Note absence of water resistance in channel.

Soil Conservation Service Photo

and smooth brome on more fertile soils are doing a fair-to-excellent job where at least a minimum of mechanical assistance and maintenance is provided. Plants are desired that will grow on slopes that are almost vertical, that will persist and climb up over soil slips and slides, that will stand washing, freezing, thawing, and drought, and that persist without maintenance work.

Two plants showing some of these qualities to a high degree are birdsfoot trefoil, usually considered for pasture purposes, and crownvetch. Birdsfoot trefoil, with which difficulty in obtaining stands on pasture land is common, has made excellent stands on raw cuts and fills. Possibly this is connected with lack of competition. Crownvetch is eventually more vigorous than birdsfoot trefoil, but it takes a year or two longer to fill in under these conditions. It is also more shade tolerant and has rhizomes. An important factor to be considered in determining which of these two practical legumes to use for bank stabilization is that crownvetch requires a more permeable soil with higher lime content than birdsfoot trefoil.

This year Iowa, after nine years of evaluation at the Ames nursery and the summarization of data from many field plantings, is closing out the crownvetch project and is recommending it for bank stabilization. Other states are not far behind. One factor aiding the acceptance of this plant was the use of seed, instead of clones as had been customary in the past. Seeding allowed much more extensive planting and gave equal or better results.

In 1954 the use of creeping bentgrass in the Cornbelt states for soil conservir.3 purposes was initiated. This grass, previously confined almost entirely to putting greens and fine lawns, shows great promise for cover on organic soils and even on soils low in organic matter where there is a good moisture supply. Here again, the use of the seaside creeping bent, of which a seed supply exists, instead of vegetative planting with stolons, allows a greater number and size of plantings.

Native grasses have application under both drought and cold, seepy conditions. Also there is a need for an annual that will protect bank and waterway seedings while at the same time growing a mulch in which perennials may later be established. Halls honeysuckle and trailing wild raspberry look good among a large number of creepers. These are being studied for special site problems.

Streambank stabilization is of growing importance. Some work is underway with purple osier willows and other woody materials including vines. Grasses and legumes are also under field evaluation. Techniques must be worked out for using materials now under trial, particularly to obtain the mechanical protection needed until the plants are established.

Figure 8. Field brome in Michigan peach orchard in June. Brome has been partially suppressed by discing except between the rows on the contour where it has been left to seed. This planting reseeded itself for four years.

Orchard Cover

There is a need for better ground cover in the cherry and peach orchards of Michigan and Wisconsin. Orchardists plant these trees on sloping land for air drainage. Erosion is severe under clean tillage. Over the years, preventing erosion by maintaining sod between the rows became an acceptable practice. However, the increased use of nitrogenous fertilizers in fruit culture resulted in heavier sod growth, and new problems developed, the chief of which was competition between sod and trees for moisture, particularly as the fruit set.

The purpose of the orchard cover project was to find a plant that met the following specifications: Provided a living cover that would (a) eliminate need for locating and hauling mulching material; (b) stand severe suppression during periods of fruit development when competition for moisture is a factor and still be able to recover and provide good winter and early spring cover; (c) be sufficiently sod-forming to support orchard equipment.

These specifications seemed nearly impossible until we heard of a winter annual grass called field brome (*Bromus arvensis*). This grass had been brought to this country from the Scandinavian countries, but only recently had it attracted the attention of the Soil Conservation Service in the Northeastern States as a promising orchard cover crop.

Field plantings in orchards were made in three cornbelt states in 1955 and each succeeding year. More data are needed before a final report can be prepared on this project, but it is significant that a number of cooperators have abandoned the "check" part of the trial and planted their whole orchard to field brome. Reports to date indicate that it will do what the orchard growers expect.

Meadow Improvement

On some soils orchardgrass, because of its lower nutrient requirements, has replaced bromegrass as a companion in alfalfa-grass mixtures. But use of orchardgrass has raised another problem. In those areas where cured hay is an important feed, common orchardgrass matures about two weeks ahead of the proper time to cut alfalfa. A poor quality hay is generally the result of these differences in maturing dates.

Field plantings with strains of late maturing orchardgrass are solving this problem. Several strains mature about two weeks later than common orchardgrass. Of these, S-37 has so far been the most desirable. By itself S-37 is less productive than some of the well known strains, such as Potomac, but our plantings so far indicate that the increased alfalfa growth combined with the more leafy S-37 results in equal or even better yields of a much higher quality hay. The results of field plantings have brought about joint recommendations by the Agricultural Experiment Stations and the Soil Conservation Service. In Ohio recommendations are made for S-37 and alfalfa mixtures for use in meadows under a wide range of conditions, while in Indiana S-37 is recommended wherever a late maturing strain is required. Under field conditions the Southland strain of bromegrass is being evaluated and compared with southern grown bromegrass in common use.

Work is also being done with a leafy ecotype of tall oatgrass found in southern Indiana.

Meadow improvement involves better combinations of grasses and legumes from the standpoint of persistence and aftermath grazing. Some possibilities in this respect being tested at the centers include a prostrate type of perennial lespedeza (*L. daurica schimidae*), Sericea lespedeza, crownvetch, button clover, Kura clover, and the pasture type alfalfas. Bermuda grass selections are being tested with legumes at Elsberry, and the Midland strain of Bermuda grass is in the field planting stage in the southern part of the Cornbelt.

Windbreaks for Mucklands

The continued development of large acreages of organic soils (commonly called muck) for agricultural use in Minnesota and Wisconsin, and to a lesser degree in Michigan, has raised several problems. Farmers' interest in these states is in single row plantings as compared to the multiple row previously recommended. Trees with a minimum of root and overhead spread, but less likely to blow over when mature, are desired. Trees must be found that can anchor themselves securely under the rapidly changing water table elevations found on some organic soil areas. Mechanical complications to consider in this work are: (1) spacing and pattern of plantings so as to decrease harmful wind velocities at seasons when deciduous trees are bare, and (2) control of snow.

Intermediate type windbreaks, shrubs 10 to 15 feet tall, which will provide supplementary protection to that given by tall, permanent tree rows and surface soil treatments, are the greatest immediate need. Many shrubs, such as honeysuckle, privet, spirea, purple willow, and some evergreens have been under extensive trial for several years. Thus far, medium purple willow (*Salix purpurea gracillis*) comes closest to meeting the needs of windbreaks for mucklands. In Michigan, truck farmers who have seen it are accepting it and are going ahead with plantings. It is readily established from rooted cuttings, and field plantings constitute a source for cuttings at this time.

Winter Cover Crops

Following the removal of corn, soybeans, tobacco, or truck crops, fields in some areas are exposed to serious erosion during the winter and early spring months. This is particularly true when crop residues are removed. Many farmers, in the southern counties of Michigan, the northern counties of Ohio and Indiana, as well as the tobacco growers in Kentucky, would use a cover crop if a suitable plant was available. The ryegrasses, tall fescue, common legumes, rye, and other cereals, have not always proven satisfactory. Perennial and annual ryegrass plantings were completely killed or badly thinned in the Tri-State boundary area of Indiana, Ohio, and Michigan during recent winters.

The Soil Conservation Service has evaluated approximately 150 field plantings of field brome in the Cornbelt states. Advantages immediately evident are its quick germination and seedling vigor, its winter hardiness and wide range of soil and moisture adaptability, its profuse stooling, and the effect of its extensive fibrous root system on soil structure.

Where it has been evaluated in comparison with other grasses, field brome has been considered superior in nearly three of every four plantings. Because of the outstanding results (1), it is being rapidly accepted by district cooperators. The Ohio Agricultural Experiment Station has included it in recommendations for winter cover, and the Soil Conservation Service is recommending it for the same purpose in two states.

Forage for Wet Sites

Developing forage for wet sites is based on the problem of better utilization of the extensive areas of low, wet lands which are low in fertility and subject to overflow. These soils usually have poor internal drainage and are most frequently found in northwestern Minnesota and northern Iowa. The results of work in the Cornbelt with Creeping foxtail (*Alopecurus arundinaceus*) show promise and this species is under increase

Figure 9. Intermediate type windbreak of spirea on an onion field in the Michigan muck soil area. Note that rows of barley further protect onion seedlings at a distance from the windbreak. Truck crop growers like the intermediate type of purple willow better than spiraea.

Figure 10. Cooperator examines massive fibrous root system of winter cover crop of field brome in early May in Michigan. Brome was planted after the last cultivation of corn and this acreage was ready to plow two weeks ahead of similar land not planted to brome.

as more field evaluation is requested. Creeping foxtail is closely related to meadow foxtail, but spreads by rhizomes and has broader leaves. It begins growth very early in the spring and remains vegetative after maturity. Reported as more palatable than Reed canarygrass, it is also more easily established and less competitive. This grass is being evaluated as a wetland pasture grass in combination with birdsfoot trefoil.

Sand lovegrass, a native of the Great Plains, has done an excellent job in stabilizing droughty, infertile blow sands in eastern Iowa and Illinois. Switchgrass has been observed to be resistant to grasshopper damage when planted with domestic grasses. A number of other native grasses, such as Indiangrass, the bluestems, and wild ryes have possibilities in the Cornbelt for seeding land in the conservation reserve program. They will generally persist without care.

Wave Action Erosion Control

There is a need for maintaining vegetation to the water's edge, especially in farm ponds and large reservoirs, to prevent the constant water edge erosion that keeps water muddy and eventually causes soil slips. Reed canarygrass and coarse grasses that will give erosion protection at the water's edge handicap the fishermen and may also throw the pond out of biological balance by providing too much protection to the more prolific small fish normally eaten by larger game fish.

Creeping bentgrass has been introduced to solve the water edge erosion problem. This grass forms the type of dense, low growing cover desired, while at the same time adapting itself to frequent and prolonged immersion. Under some conditions it can survive underwater near the edges, a quality which may not be in its favor insofar as the biological balance is concerned. It does not provide complete cover away from moisture to the top of the higher banks. Further evaluation is needed before recommending the general use of creeping bentgrass. If its waterside qualities are found to be suitable, a small amount of seed mixed with a grass that will stand drier conditions should provide ideal protection from waters edge to the top of the bank.

Hillculture

In some soil conservation districts there are cooperators who show considerable interest in obtaining some economic return from the many small, rough, and inaccessible areas on their farms. Information is requested about such specialized crops as Christmas trees, nuts, wild fruits, and fence posts. A start has been made in putting a number of selected strains of Scotch pine with desirable Christmas tree characteristics, as well as chestnuts and locusts wth blight and borer resistant potential, under observation at the centers.

Grass and Legume Educational Plots

Some 20 or more grasses and legumes used in Cornbelt plant materials plantings are made available in packages containing enough seed to plant plots 10 by 20 feet of each variety. Usually, half of each plot is mowed and the other half left to mature—thus, sod forming and recovery characteristics are demonstrated. These projects are almost always planted and maintained by Vocational Agriculture classes in cooperation with the Soil Conservation Service and the soil conservation district. The plots are labeled and accessible for study. This project is so popular in two states that almost every soil conservation district has one.

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How Drainage Affects the Economics of Fertilizer Use on a Fine Textured Soil

R. H. BLOSSER

Although Paulding soils cover only 350,000 acres of land, results of this study should apply to about two million acres in the Old Lake Bed areas of northwestern Ohio, southern Michigan and northeastern Indiana. Also, the general principles involved should apply to a large portion of the poorly drained land in the Cornbelt.

PROFITS FROM FERTILIZER are influenced by many factors. The more important ones include rate of application, soil type, past land management, soil drainage, amount of rainfall, time of planting crops, plant population, crop varieties used, and control of weeds, insects and plant diseases.

This study shows how drainage affects the profitable use of fertilizer on Paulding and related soils. Paulding soil is found on flat areas in northwestern Ohio where more than 42 inches of heavy waterlaid clay rests on glacial till which also has a high clay content. The top 6 inches are gray to dark gray in color. The texture is a clay which is smooth and sticky when wet and extremely hard when dry. Deep cracks usually develop during droughty periods.

Drainage through tile is slow because of a clay content ranging from 60-80 percent. Surface drainage also is poor because of the level topography. Tests show that Paulding soil is high in potassium but low in available phosphorus. Usually little or no lime is needed. Organic matter is moderately high.

Methods of Study

Data on land use, crop yields, fertility practices, drainage and livestock numbers were collected on 92 farms for 1954 and 97 farms for 1955 and 1956. Each farm had more than 90 percent Paulding soil. Continuous records were obtained on 85 of these farms. This study was confined to Paulding County, Ohio, because detailed soils maps were available for all farms. Farms in other areas could not be used because maps showing specific locations of Paulding soil were not available. If this study had covered several counties, variations in yields due to differences in rainfall probably would have been greater.

In selecting the sample farms, the objective was to obtain a sufficient amount of data on each land management practice so that input-output relationships could be determined for as wide a range in conditions as possible. From the data obtained, crop yields were determined for different degrees of drainage and applications of fertilizer by a combination of sorting and correlation analysis. These yields were then used to calculate the economics of fertilizer use for different drainage situations.

Description of Farms Studied

Acreages of various crops are shown by drainage groups in table 1 for 82 farms on which continuous records were obtained for the 3-year period, 1954-56. Although 85 farmers furnished continuous records, three farms could not be used in preparing this table because of changes in size. In most cases, total acreage included only the main tract of land. Therefore, many farming units contained more acres than are shown in Table 1. The number of farms in each drainage group was as follows: below average, 34; average, 26; and above average, 22.

Percent of rotated land in corn and soybeans averaged about the same for each drainage group from 1954 to 1956. But on the best drained group of farms, the percent of corn raised averaged almost one-half higher than the amount reported for the poorest drained group. The

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TABLE 1

Land Use on 82 Farms on Which Continuous Records Were Obtained, 1954-56

Land Use	Average for 1954-56		
	Below average drainage	*Average drainage*	*Above average drainage*
	Acres	*Acres*	*Acres*
Corn	19	23	38
Soybeans	56	53	68
Oats	12	13	23
Wheat	20	15	23
Meadow	25	23	38
Idle	1	1	0
Rotated crops	133	128	199
Permanent pasture	9	5	5
Woods and miscellaneous	24	16	13
Total	166	149	208

combined percentage of oats and wheat averaged about the same for each drainage group. However, the most poorly drained farms had a smaller percentage of oats than the ones with above average drainage. Each drainage group had about 20 percent meadow crops in the rotation.

Average crop yields for all farms are shown in table 2. The high yields of corn, soybeans and oats in 1954 were largely due to an ideal distribution of rainfall during the planting and growing season. From 1954-56, the best drained group of farms produced 45 percent more corn, 52 percent more oats, 32 percent more soybeans and 17 percent more wheat per acre than the poorest drained group.

Only a small number of livestock were kept on the farms studied. The average number per farm was as follows: Dairy cows, 2.8; beef cows, 0.3; slaughter cattle, 1.8; ewes, 2.0; market hogs, 10; and hens, 40. On about one-third of these farms no livestock of any kind was reported. Only 8 farms had 10 or more dairy cows. Tracts of land that were not main units seldom had any livestock. The principal reason given for not raising more livestock was that grazing animals often packed the soil to the point where it became practically impossible to prepare a satisfactory seedbed for corn and sometimes difficult to prepare one for soybeans.

Drainage Ratings Calculated

In determining a drainage rating for each farm, consideration was given to the following: Distance between tile lines, number and type of surface drains, amount of water that collected in small ponds after rains, and the farmer's estimate of whether his land was better or more poorly drained than other tracts in the community. Every farm had some tile. On the poorly drained farms, tile lines were spaced about 100 feet apart. But on the best drained farms, tile lines averaged about 50 feet apart.

On almost every farm plowing was done in narrow strips with dead furrows running at approximately right angles to road ditches or other designed outlets. This system of drainage gave poor results on some farms because of inadequate outlets and the collection of water in low places. Ponding areas usually were due to the natural slope of the land or to change in direction of plowing the fields.

TABLE 2
Average Crop Yields by Drainage Groups, 1954-56

Drainage ratings	1954	1955	1956	1954-56
	Bushels	*Bushels*	*Bushels*	*Bushels*
Corn				
Below average	56	46	45	49
Average	74	57	57	63
Above average	79	68	65	71
Soybeans				
Below average	22	18	16	19
Average	25	19	19	21
Above average	29	23	22	25
Oats				
Below average	36	29	23	29
Average	44	30	26	33
Above average	53	40	38	44
Wheat				
Below average	23	23	24	23
Average	25	25	26	25
Above average	27	25	29	27

Figure 1. On many poorly drained soils more tile lines and surface drains are needed to make moderate applications of commercial fertilizer profitable.

Several farms had a highly effective system of surface drainage that had been established under the supervision of the local soil conservation district. It consisted of plowing in narrow strips and emptying the open dead furrows into newly established outlets about 500 feet apart. Land leveling was also done to eliminate shallow depressions that previously were too low to drain through the dead furrows.

Fertilizer Response Influenced by Drainage

Corn yields in table 3 show how drainage affected the response from certain applications of fertilizer from

TABLE 3
Bushels of Corn per Acre for Paulding Soil with Different Applications of Fertilizer and Degrees of Drainage, 1954-56

Year	Fertilizer used per acre pounds[1]	Drainage rating: Below average	Average	Above average
1954	0	50	63	70
	150	55	69	76
	300	58	74	81
	450	—	78	85
1955	0	45	45	52
	150	45	50	61
	300	44	55	70
	450	—	60	78
1956	0	40	41	49
	150	43	48	56
	300	46	56	63
	450	—	64	69
Average	0	45	50	57
	150	48	56	64
	300	49	62	71
	450	—	67	77

[1]Applications of 300 pounds or less were usually made with the planter. But rates above 300 pounds usually consisted of a broadcast and starter application.

1954 to 1956. Fertilizer rates are in terms of 3-12-12 analysis which was the kind most commonly used. Adjustments to this analysis were made by giving each fertilizing element the same yield increasing value. For example, 100 pounds of 3-12-12 were considered to be equal to 135 pounds of a 2-12-6 analysis or 108 pounds of a 5-10-10 fertilizer. The fact was recognized that fertilizing elements are not exact substitutes for each other. However, this method of adjustment was considered practical in this study because most farmers applied a complete fertilizer.

Data for 1954 show that Paulding soil will produce high corn yields under ideal conditions. The 1954 crop was planted unusually early because of a dry April and May. Combined rainfall for these 2 months was 1.8 inches below normal at the local weather station. Good to excellent stands occurred because rains were not heavy enough to crust the seedbed after the crop was planted; yet they were heavy enough and came at the right time to germinate the seed properly. Above normal rainfall during the growing season also contributed to the production of above average yields.

Corn yields for all farms averaged about 12 bushels less for 1955 than 1954. On many farms, stands were poor because of cloddy seedbeds and lack of rain at time of seed germination. Unless rains come at the right time, cloddy seedbeds are usually too dry to produce the desired plant population. These same conditions also produce considerable variations in the growth of individual plants. Cloddy seedbeds were principally due to tilling the soil when it was too wet. This situation was especially noticeable on land that had been plowed late in the spring. Stands were rated by farmers as follows: Good on about 50 percent of the farms, fair on about 30 percent, and poor on the remaining 20 percent.

Corn yields for all farms averaged nearly 3 bushels less for 1956 than 1955. Plantings were late because of a wet spring. Also, too much rain during the early part of June retarded normal growth, especially on the poorly drained land. Stands were rated by the farmers as follows: Good on about 60 percent of the farms, fair on about 30 percent and poor on the remaining 10 percent.

Good drainage and moderate applications of fertilizer were needed to maximize corn yields during the three-year period. When no fertilizer was used, the best drained farms averaged 12 bushels more corn per acre than the most poorly drained group. But when 300 pounds of fertilizer per acre were used, differences in yield for these two drainage groups increased to 22 bushels of corn per acre.

Yield increases from fertilizer depended upon how well the land was drained and the amount and distribution of rainfall, particularly during the planting season. Average yields for the three-year period showed applications of fertilizer above 150 pounds per acre increased production only slightly when applied to below average drained land. But on the best drained group of farms, 450 pounds of fertilizer per acre increased corn yields 6 bushels above a 300 pound application. Yields for the poorest drained group of farms could not be determined for 450 pounds of fertilizer per acre because this application was beyond the limits of the data obtained. On the best drained land, data were inadequate for measuring fertilizer response beyond 450 pounds.

Poor stands may be a partial explanation of the way corn responded to the different fertilizer applications in 1955. No data were obtained on the number of corn plants raised per acre. However, each farmer rated his stand on the basis of poor, fair and good for each of the 3 years. For comparative purposes numerical ratings were given as follows: 1 for poor, 2 for fair and 3 for good. On this basis, stands for 1955 averaged 2.0 for the farms having below average drainage, 2.4 for the average drained farms and 2.6 for the group having above average drainage. Stands for each drainage group averaged about the same for 1954. These same relationships also occurred in 1956.

Effects of fertilizer and drainage on oat yields are shown in table 4. Oats were raised on only about two-thirds of the farms in this study. Yields were highest in 1954 because of a relatively good planting and growing season. Approximately two-thirds of the plantings for this year were made about the middle of March.

Yields on all farms averaged nearly 12 bushels less in 1955 than 1954. Potential yields were reduced because of late plantings and below normal rainfall in June. Over half the plantings were made around the middle of April. Yields for 1956 averaged approximately 4 bushels less than in 1955. Late plantings were largely responsible for these low yields.

Poor drainage of Paulding soil probably reduces oat yields more than any other single factor because of late planting. On the below average drainage group of farms,

TABLE 4
Bushels of Oats per Acre for Paulding Soil with Different Applications of Fertilizer and Degrees of Drainage, 1954-56.

Fertilizer used		*Drainage rating*		
Year	*per acre, lbs.*	*Below average*	*Average*	*Above average*
1954	0	32	40	45
	200	40	49	55
	300	42	53	59
1955	0	30	30	30
	200	28	31	39
	300	28	31	42
1956	0	20	23	27
	200	24	29	33
	300	25	35	40
Average	0	27	31	34
	200	31	36	42
	300	32	40	47

300 pounds of fertilizer increased the average annual yield of oats only 5 bushels. But on the above average drainage group, this same amount of fertilizer increased the average annual yield 13 bushels.

Soybean and wheat yields also were correlated with different degrees of drainage and applications of fertilizer. Wheat yields were correlated with the entire amount applied to this crop. Soybean yields were correlated with the amount used on other crops because no fertilizer was applied directly to this crop. This analysis showed that drainage did not change significantly the shape of the fertilizer response curve for soybeans and wheat. In other words, yield response from given amounts of fertilizer was about the same regardless of drainage classification. This may be largely explained by the fact that soybeans and wheat were normally planted at a time when the soil was drier than was the case with corn and oats.

Economics of Fertilizer Use

Profits from different applications of fertilizer are shown in table 5 for three degrees of drainage. These calculations were made by subtracting the cost of the fertilizer applied to each crop from the market value of the additional yield obtained. Other costs were not considered because they did not change significantly when more fertilizer was used. Residual effects of fertilizer were omitted from the calculations because no satisfactory estimates could be made to cover the various applications and drainage situations. Yield increases used to determine the value of the additional crops produced by different amounts of fertilizer were taken from data presented in Tables 3 and 4. Corn was figured at $1.35 and oats at $.70 per bushel for calculating net income above all additional costs. Charges for fertilizer were figured on the basis of a 3-12-12 analysis which cost 2.5 cents a pound.

TABLE 5
Net Income Above Additional Cost of Using Different Amounts of Fertilizer on Paulding Soil[1]

Crop	Fertilizer used	Drainage rating: Below average	Average	Above average
Corn	1st 150 lbs.	$ .30	$4.35	$5.70
	Next 150 lbs.	—2.40	4.35	5.70
	Next 150 lbs.	—	3.00	4.35
Oats	1st 200 lbs.	—2.20	—1.50	.60
	Next 100 lbs.	—1.80	.30	1.00

[1]The entire cost of fertilizer was charged against the crop on which application was made.

Net income figures show that good drainage is necessary to make moderate applications of fertilizer profitable on Paulding soil. On the poorly drained land, the first 150 pounds applied to corn gave only a small increase in net income when all fertilizer was charged against this crop. The second 150 pounds did not produce enough additional corn to completely pay for the fertilizer. However, this second increment might increase soybean yields enough to justify its use. Profits from a third increment of 150 pounds of fertilizer on corn could not be determined for poorly drained land because this application was beyond the limits of the data obtained in this study. This would indicate that most farmers on poorly drained land did not think it would be profitable to use more than 300 pounds of fertilizer per acre on corn. On the best drained land, fertilizer increased corn yields enough to pay for a 450 pound application. Profits from larger applications could not be determined from the data available.

Figure 2. Paulding soil is difficult to manage because of level topography and fine texture.

On below average drained land, fertilizer did not increase oat yields enough to pay for a 200-pound application per acre. But on the best drained land, 300 pounds per acre increased oat yields enough to slightly more than pay all fertilizer costs. On the poorly drained land, applications of fertilizer on oats would have to be justified largely on the basis of higher yields from succeeding crops.

Figures in this study do not always show the uniform relationships that might be expected to exist. This situation is not unusual because large variations in yields are charactristic of Paulding soil, even under experimental tests. Experimental studies on similar soils showed less response from fertilizer than this study (1). This apparent discrepancy may be largely explained by the fact that Paulding soil has rcently been used to grow a very high percentage of soybeans which are seldom fertilized. Consequently, mineral nutrients are probably depleted to the point where moderate applications of fertilizer on other grain crops are now profitable.

Data from this study would indicate that on many poorly drained soils more tile lines and surface drains are needed to make heavy applications of commercial fertilizer profitable. More fertilizer will increase yields only when other growth producing factors are favorable.

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Streambank Stabilization

HARRY L. PORTER, JR., AND LEON F. SILBERBERGER

THIS REPORT describes vegetative field-planting efforts on streambanks in the Buffalo Creek Flood Prevention Project during the past decade. Finding the most suitable plants and methods for bank stabilization was an imperative need.

Buffalo Creek Watershed covers an area 437 square miles in northwestern New York State, with 21 square miles lying within the city limits of Buffalo. The last 6 miles of the creek is known as Buffalo River and is an important part of the harbor at Buffalo.

The Buffalo Creek Flood Prevention Project was authorized under the Flood Control Act of December 22, 1944, as amended in 1946. The reduction of sediment deposits in Buffalo Harbor is the major benefit of this project. Flood control, where it can be accomplished, is a part of the project and part of the benefits are claimed for this work.

The greater part of the watershed lies in the Allegheny Plateau. A small portion is in the Erie-Ontario plain. The slopes in the watershed are very long and the hills rise from 600 to 1,000 feet above the valley floor. Precipitation averages about 38 inches annually. Winter floods with large ice floes are common and add to streambank stabilization problems.

The problems of establishing vegetation are tied closely to the construction and re-alignment work being done. The early work consisted of bulldozing local deposits of sand, gravel and rock against the eroding banks for toe-protection. The curves were smoothed and the banks sloped for shrub planting. Approximately 16 miles of bank were treated in this manner, but the bank material was generally unsuitable for plant growth.

Since 1950, a more "permanent" stabilization job has been done. The toe and lower banks have been rip-rapped with quarried rock, and the upper bank planted.

With both systems, vegetation was a planned part of the stabilization program, and included in the engineering design. Channel control is based on both structural and vegetative methods.

In addition to protecting the streambank, a cover must be established on the adjoining areas disturbed by construction operations. This is particularly important when such areas are subject to bank overflow.

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Early Plantings

The first shrub plantings were made in 1949. Species selection and planting practice were influenced by experiences and results with them on the Winooski River in Vermont, where unrooted cuttings of purple osier willow (*Salix purpurea*) and red osier dogwood (*Cornus stolonifera*) produced outstanding results (1). On Buffalo Creek unrooted willow was used in 1949 and 1950. Rooted cuttings have been used since 1950. Small sections of the banks were planted to shrub species such as silky dogwood, sand cherry, coralberry, tatarian honeysuckle and Wichura rose in 1950.

In these plantings, shrubs were being relied upon for protecting the banks. Seedings of timothy, ryegrass and alsike clover were made on the level construction-disturbed areas along the top of the banks. Along two or three reaches of the reshaped streambank, however, these grasses and legumes were seeded and became established among the willows.

Early in 1952, a survey after an early spring flood revealed that the combination of grasses and willow was superior to willow alone. Shrubs alone did not provide the necessary protection until several years after planting.

Test Plantings Established

There was a need for more field plantings to determine the most suitable species and combination of plants to use. It was obvious that quick establishment of a protective cover was essential. Grass-legume mixtures offered much promise for initial protection. Specifically, plants to be used must establish well under severe soil conditions, be long lived, and have minimum maintenance requirements. They must survive the beatings from impact and abrasion by transported materials and should also maintain effective protection during the dormant season when floods are most likely to occur. It seemed that shrubs would ultimately provide the best protection against the heavy ice floes, and shade-tolerant grasses were needed in the understory to protect against the scour of flowing water.

It was decided to test the more promising grasses and legumes at several different locations. In May 1952, three plantings of crown vetch were made on newly shaped banks by broadcasting seed on the area above the rip-rip and raking it in by hand.

In 1953, plantings of several grasses were made at five

different locations on Buffalo Creek. These sites were on the outside banks in bends immediately above the rip-rap and therefore in exposed locations. Each planting site was fertilized with 5-10-5 at the rate of 500 pounds per acre. No lime was needed. The seedbed was prepared by hand raking.

At each planting site, 12 plots 10 by 20 feet were marked. One plot of each of the following was seeded: tall fescue, red fescue, tall oatgrass, smooth bromegrass, Reed canarygrass, Empire birdsfoot trefoil and crown vetch. The five grass species were repeated in the last 5 plots; these plots were then split and Empire birdsfoot trefoil seeded on one half and crown vetch on the other half of each plot. The seed was broadcast by hand, raked in lightly and mulched with straw at the rate of 2 tons per acre.

A flood on May 26, 1953, completely destroyed the plots at three locations. One series was re-established in September 1953, but two were not damaged seriously enough to warrant seeding again.

All banks which have been reshaped since 1954 were seeded to one of the following mixtures: (1) tall fescue, ryegrass and crown vetch, or (2) red fescue, ryegrass and birdsfoot trefoil. Ryegrass in small quantities was added to help insure quick cover. A composite of attributes of the species in each mixture gave most of the desired protective characteristics.

From 1951 to 1956, most of the shrubs in the streambank plantings consisted of a single row of silky dogwood just above the rip-rap, with purple osier willow planted on the remainder of the bank. In 1956, solid plantings of silky dogwood, dwarf purple osier willow (*salix purpurea nana*) and Wichura rose were tried and they are still being evaluated. Slender willow (*Salix purpurea gracilis*) was added to the plantings in 1958.

Improvement in Techniques Needed

As the field plantings progressed the need for the improvement of establishment techniques became apparent. Several problems were encountered. Of these, low moisture availability seemed the most severe. The planting sites were either so hard packed after construction that water intake was slow, or there were loose gravelly areas with low water holding capacity. A small portable irrigation system was put into use in 1954.

It was quickly apparent that water alone was not enough. Nitrogen deficiency showed up within 40-60 days after seeding. Ammonium was applied in August 1954 through the irrigation system to a new seeding series, at the rates of 50, 100, and 200 pounds per acre. Within 10 days after application all rates had doubled the size of seedlings over those in the untreated area. No difference in rate of plant growth could be detected between the different rates of ammonium nitrate application. These findings, and experience since then, have indicated that excellent results are obtained by applying 50 pounds of ammonium nitrate per acre at monthly intervals until the seeding is well established.

Unfavorable seeding dates were somewhat offset by irrigation and nitrogen application, but more attention was paid to scheduling completion of construction jobs within suitable seeding periods. Mulching, first started in 1956, has helped to extend the suitable seeding season as well as hasten stand establishment. Nearly all seedings are now mulched with wood chips. Chances for good stand establishment were further improved by requiring contractors to stockpile top soil or fine material for use in finishing the planting site.

Rooted cuttings were continued along with the seedings on all work since 1953. Improvements were made by (1) planting only during the early spring, (2) cutting

Figure 1. This curve on Buffalo Creek was subjected to high water in 1952. Note the grass cover and the lack of damage. Stabilization work has consisted of shaping the eroded bank, stabilizing the toe with rock rip-rap and establishment of grass-willow cover. The same curve (below) withstood the severe flood of May 26, 1953.

back willows in the nursery during the winter before spring planting, and (3) lifting dormant willows at the nursery very early and healing in at the planting sites.

These Plants Look Promising

Crown vetch established well on loose gravelly sites where few other plants would grow. It exhibited excellent ability to fill in and heal the scoured areas. Birdsfoot trefoil has also performed well. Crown vetch has spread by rhizomes but the trefoil apparently has spread by reseeding. Neither of these plants, however, has much "toughness" in their above-ground parts. Another disadvantage is that their tops are dead and brittle and afford little protection during the winter and early spring. This disadvantage is offset by using grasses along with the legumes. The outstanding mixtures are (1) tall fescue and crown vetch, (2) red fescue and birdsfoot trefoil, and (3) tall fescue and birdsfoot trefoil. The fescues have tough leaves (even through the dormant season), are compatible with the legumes, require a minimum of maintenance, and consistently establish well.

For dry banks Wichura rose looks promising, but it needs additional evaluation. Some of the other willows, particularly slender willow (*Salix purpurea gracilis*), may replace common purple osier, but it also needs further evaluation.

Most of the plantings have been subjected to severe floods. (There are normally about 20 floods per year on Buffalo Creek and eight or nine of these are large floods.) The five series of small plots were inundated May 26, 1953, shortly after seeding, by a flood estimated to be the probable maximum in a 35-year period. This flood scoured about 6 inches of material from one series of grass plots near the intersection of Buffalo Creek and State Road 78. Although other floods have occurred, the only significant damage on these plots, once they were established, was during a January 1957 flood which carried large ice floes.

Figure 2. Full grown purple osier willow now protects this bank on Buffalo Creek against damage by ice and debris. Stone rip-rap protects the toe and lower bank. Shade tolerant grasses in the shrub understory protect the bank against scour by flowing water.

All plantings on Buffalo Creek have been protected against damage by livestock and farming operations. This is considered necessary to maintain an adequate cover.

Engineering Aspects

From the engineer's point of view, there is strong evidence that vegetation cannot be used on Buffalo Creek where the forces acting on it are so great that it cannot be established or maintained. It becomes important then to have some measure of the forces which different bank protection measures will withstand. It was estimated that the stream velocity at the peak of the March 7, 1956, flood was 9.5 feet per second and the average boundary drag (shear stress) on the channel boundary was 1.4 pounds per square foot (Donald A. Parsons—unpublished correspondence). The measurements for these estimates were taken near the grass and legume plots and these plots safely handled this flow. Ree and Palmer show the velocities which several grass species will withstand for flows in uniform channel (2). As a guide for showing the relative resistance of vegetation and stone, Parsons (referring to the data presented by Ree and Palmer) calculated the allowable shear stress for one grass (Bermuda) and listed stone sizes which would furnish equivalent protection.

Description of Grass Stand	*Allowable Stress-lbs./sq. ft.*	*Equivalent Stone Size —inches*
Fair stand, short dormant	0.9	2
Good stand, kept short, dormant	1.1	2
Good stand, long dormant	2.8	5.5
Excellent stand, kept short, green	2.7	5.5
Good stand, long, green	3.2	6.5

At the present time there appears to be no vegetation which will stabilize the critical toe of an eroding bank.

The planned use of vegetation assumes the ability to have it when and where it is needed. On the Winooski River, brush mats provided protection until the vegetation became well established (1). The cost consideration ruled against brush mats on Buffalo Creek. Experience with the earlier work where shrubs alone were used has shown that it will take from four to seven years for these plantings to become effective cover. Fertilization and mulching of legume and grass seedings, along with irrigation and top dressing with nitrogen, have produced fairly good grass-legume cover in one growing season. Some protection is provided a streambank in 35 to 50 days after seeding. There is the ever-present risk of failure during the stand establishment period unless some temporary protection is used. Techniques developed on the Buffalo Creek plantings have shortened this period and have reduced failures significantly.

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Man, Land and Technology

ELMER L. SAUER

Elmer L. Sauer is President of the Soil Conservation Society of America. This article is the text of his keynote address delivered August 29, 1960, at the Fifteenth Annual Meeting of the Society.

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PROGRESS in natural resource conservation depends upon bolstering our present knowledge in this field. At one time the essential element in agriculture was land. Later, capital became more important. Now the most important element in the triumvirate of land, labor, and capital is labor combined with management; man is the most essential element. Our future in soil and water conservation depends on "brain power." Our *Society*, in its dedication to the advancement of the science and art of good land use, is ever alert for methods that will help achieve the needed conservation of our soil and water resources.

The early philosophers pointed out "there is no progress without change." As members of a world community in this atomic age we find change extremely rapid. We must run to keep pace with the changes if real progress is to be achieved.

"International men of tomorrow" must keep before them the changing tableau of the universe, including outer space, ever keeping in focus the picture of their native lands. My personal knowledge is largely and most specifically of conditions in the United States; hence, the material presented here concerns, for the most part, the United States. *SCSA* members and fellow workers representing other countries may find this picture helpful in connection with their soil and water conservation problems.

Resources: Land, Water and Man

The rapid population growth, not only in the United States but all over the world, dictates that natural resources (soil, water, grass, timber and wildlife) receive their deserved attention. In the United States, we have a population growth of about 1.7 percent each year. There is an increased per capita drain on our natural resources, due to the steadily rising level of living. World political conditions are turbulent. To maintain and improve living standards, we need to conserve, improve, and make the best use of all of our renewable natural resources.

The United States Census Bureau estimates that by the year 2010 we will have 370 million people, more than double our present population. In terms of today's production, this population would require more than a billion acres of cropland. We have at the present time the equivalent of 540 million acres of cropland, including total acreage in crops plus productive pastures. The possibilities for an increase in crop acreage are limited. Although we might drain some additional land, clear some unproductive woodland, increase the area of irrigated land, and make some improvement in ranges, we are certain to lose additional land each year to the expanding urban population.

Thus, in the years ahead, we must improve our resources and increase per unit production tremendously. While it is estimated that we will need to improve farm practices and production at the rate of 160 percent as great as that experienced in the last two decades to provide food and fiber needs by the year 2000, there is no question but that it is scientifically possible to increase farm production much faster than the population expansion.

By the year 2000 the nation's population will probably be 85 percent urban. The per capita use of urban land will probably double during the period 1950 to 2000. The increased population will require approximately 82,000 square miles of urban area, or approximately 3 percent of the land area of the United States. This is significant when related to the total area in cropland. In 1950 the total area in cropland was 640 thousand square miles or slightly over 21 percent of the nation's total land area, and the area in Class I farm land (our very best land) amounted to only 3.8 percent of the total land area.

We will need much more area in city, regional and national parks and in lakes for recreational use of our expanding population.

With an expected loss of approximately 2 million acres of cropland annually to highway, urban and industrial expansion, the pressure on the remaining land will become more intense. In 1950 we had 3.1 acres of cropland per person. In 1975 we probably will have 2.2 acres, and by 2000 only 1.6 acres. If present proven improved practices were applied to all cropland, present production would be almost doubled. Also, while the population has been growing at a rate of 1.7 percent each year,

agricultural production has been increasing approximately 2 percent each year.

Although we now have overproduction of some agricultural products, this is something for which to be thankful. Because of both dwindling crop acreage and increasing population, we should give particular emphasis to conservation of the acreage presently not needed in order to have it available and productive when it is needed.

We must have more careful analysis, planning, and zoning of good agricultural lands to prevent their unnecessary removal for highways, urban and suburban development, industrial sites and other nonagricultural uses. Less productive lands can be used for such purposes.

Water Resources

Water is a vital natural resource. It is becoming more limited in the United States. This was dramatized at the Seventh National Watershed Congress in Washington, D. C., on April 18, 1960, when the water conservation commemorative postage stamp was issued. The presentation statement read in part: "Our national and personal needs for water for domestic use, for sanitation, for manufacture and for agriculture are multiplied each year by our expanding population but there is just so much water. We can meet these vital and rising demands for water only by better use of what we have, by reducing needless waste and pollution, by protecting the watershed upon which our water falls as rain and snow and by finding more efficient ways for its use.

"Most problems of water shortage, poor water, or floods trace back directly to the land. Whether the land in each watershed is eroded or is mantled by a protective cover of grass and trees, whether there are small dams and other flood prevention structures along the channels, whether steps have been taken to reduce pollution—these determine in a large measure whether water supplies are ample and reliable."

Improvements and advancements in the conversion of sea water and brackish waters to fresh water equivalent may, in another 10 years, be of substantial help in meeting the growing water needs. Fund allotments for successful and economical conversion of sea and brackish water to fresh water equivalent are infinitesimal compared to its significance.

The United States Senate recognized the vital importance of water and water resources in our growing national economy by establishing the Select Senate Committee on National Water Resources in the 86th Congress. The Senate charged the committee to make studies of the nation's water resources problems as a basis for recommendations to the Senate on water resources policies for the future.

Detailed committee reports point out that almost every part of the United States faces either current or potential water problems. The reports point out that the six major problems which must be solved with respect to water are *supply, variability, distribution, floods, quality* and *pollution*. While these problems can be solved, some of the solutions are going to be costly.

Senate Select Committee Print No. 28 entitled, "Water Resources and Research Needs" states, in part: "Proper water management encompasses the best use, control and conservation of water that can be accomplished. The goal is the production of valuable agricultural and forest products making the best use of available water with a minimum waste of that water. The demands of a growing population on a relatively fixed quantity of water inevitably increase. Research offers the major opportunity to extend existing water supplies over these increased demands."

Canada's Resources

Canada's vast natural resources, compared to those of the United States, are just opening up. With 3,845,144 square miles of area (234,028 of which is inland water) Canada is the third largest country in the world. The 1959 population of Canada was estimated at 16,081,000.

The future of Canada is closely connected with the development of its natural resources. Fertile soils are the greatest natural resource of Canada. It is estimated that over 350 million acres of land can be used for farms and this is approximately four times the area now in such use. Forest resources cover about one-third of the land area of Canada. Three out of four U. S. newspapers are printed on paper made from wood pulp produced in Canada.

Other great resources of Canada include grass, wildlife, fish and minerals. While Canada is third in world agricultural production, she is first in production of nickel, newsprint, asbestos and platinum; second in gold, aluminum, and wood pulp; and third in the production of zinc, silver and uranium.

The conservation and development of natural resources (including water and water power) carried on by the Dominion and Provincial governments should place and keep Canada among the world's leaders.

SCSA and Resource Conservation

The basic objectives of the *Soil Conservation Society of America* are the development and advancement of the science and art of good land use and management and the promotion of conservation of soil, water and related renewable natural resources including, without limitation, trees, grass, fish, wildlife, and all other forms of beneficial plant and animal life, and for these purposes to employ education of the people and other appropriate means to

the end that mankind may have the use and enjoyment of these resources forever.

The *Society* has placed increased emphasis on sound development, management and use of soil, water, and other renewable natural resources. *Society* committees are working in these various fields. We have an international committee on water resources management, another committee on land use, and a third committee studying the problem of wetlands.

The Water Resources Committee has prepared and published a statement on "General Principles of a National Water Resources Policy." This statement has been distributed to key agencies, organizations and individuals and is regarded as a forward step in the formulation of a sound national water resources policy.

The *Society* recently published a 20 page brochure entitled, "Snow Surveys and Water Supply Forecasts," and another 20 page brochure entitled, "Report of Wetlands Committee of the *Soil Conservation Society of America*." The Land Utilization Committee is working on problems of land and water use management. We have also prepared publications of a popular nature to promote soil and water conservation. These have had wide distribution throughout the nation. In addition, *Society* leaders represent the *Society* and membership at numerous meetings and workshops with other groups and agencies on a national and international level.

Increased Emphasis on Human Values Needed

Increased emphasis on trained manpower will help achieve our natural resources conservation goal. However, we need to continually encourage those human aspirations that make the American economy work. We have a moral obligation to preserve and advance the material and moral contributions which the family unit farming systems have given to our democracy. The increasing tendency to largeness, including the so-called "factory-type" farms, creates problems with which we must all concern ourselves.

If immediate economic gains are the prime and only goal, we will find it more and more difficult for effective establishment of sound soil and water conservation plans on the land. It is interesting to note that the strongest advocates of so-called "free competition" for farmers usually are not the family farm operators but those who operate their businesses with all kinds of economic restraints. Some economists predict that 50 percent or more of the farmers need to "go broke" and get out of farming so that we will have a healthy agriculture. I question that this is healthy for either the farmers or the rest of the population.

Part of the current United States surpluses of corn, wheat and cotton is due to soil mining, overcropping and improper land use and rotations. Correcting land use (use within capability classes) would aid materially in balancing production with consumption. There can be sound, workable farm programs. American agriculture must devise a way of sharing its bounty with the "hungry" nations of the world, but still preserve and improve basic land, water and human resources and let our borrowing or buying neighbor nations of the world preserve their self-respect.

Research in Soil and Water Conservation

Agricultural research has played a vital part in making possible the high U. S. industrial economy and a high standard of living. Technological advances in agriculture have released labor to produce other goods and services. In 1910 one farm worker produced enough food for only 7 persons. In 1957 one worker produced enough for 23 persons. Research has provided the basis for the development of our efficient system of producing food, feed, fiber, and forest products.

This country's agricultural research owes much of its great success to cooperation. About 90 percent of the United States Department of Agriculture research is cooperative with other organizations, primarily the State Agricultural Experiment Stations, but also with State and Federal agencies, industry, institutions, universities, farm organizations, trade associations, and other groups. Technological advances in agriculture and industry are mutually interdependent. They have made possible the present high levels of living for farm and city people alike.

The two most familiar questions that need to be answered for new farm practices developed through research are: Will it work? and Will it pay? These questions bring up the fact that most studies involve both natural science and economics.

The Committee on Research Evaluation[1] report "An Appraisal of Agricultural Research and the Road Ahead"[2] states in part: "Generally we will have to place greater stress on basic research; reduce wastes and losses; improve efficiency of production, processing, marketing, and consumption; develop new and improved crops and markets; expand markets; and provide better nutrition and living for farm and city people. At the same time, we will have to conserve and improve our basic natural resources of soil, water, forests and ranges."

This report shows that our nation is dependent on agriculture for an adequate and economical supply of farm and forest products, for the needs of national defense, for changing needs resulting from population increase, foreign trade conditions, new uses for farm and forest prod-

[1] A group of United States Department of Agriculture and State scientists which conducted one of the most comprehensive studies of agricultural research in the history of the Nation.
[2] U. S. Dept. of Agriculture Information Bulletin 221, 1960.

ucts, development of competitive products, dietary improvements and other advances in levels of living.

Achieving Soil and Water Conservation

Soil Conservation Districts provide an opportunity for local leadership to be effective in soil and water conservation programs. Watershed programs are a means of using group action to get complete soil and water conservation on the land combined with mechanical measures that help to reduce flood and sedimentation damages both on and off the watershed.

The small watershed approach recognizes that soil management and water management are inseparable. This program is an implementing tool to work on problems that require community action. Watershed protection and flood prevention in upstream watersheds contribute to the retarding of floods downstream. The basic conservation farm plan is the backbone of a soil and water conservation program in watersheds as well as on individual farms.

Much of the nation's productive land resources are under private ownership and most of the usable land and water resources are used under rights of private ownership or control. Also, a large proportion of our forest resources are in private ownership. The farmer, rancher, and forest land owner decide how land is to be used and what conservation measures are to be applied on the land. Hence, the conservation program must be economical and feasible as well as provide the kind of living desired by the owners and operators of the land.

There are many values in conservation. The basic needs for food, fiber, water, and wood are of first importance. Other important values such as recreation, fish and wildlife, scenery and aesthetic values found in the out-of-doors and on the land, are highly desirable but are not likely to be achieved unless we provide for the basic needs with a conservation program that will pay off.

Economics of Conservation

To maximize income a farm family must have adequate land and capital resources, and must possess a reasonably good knowledge of their alternative uses in farming.

Economic studies demonstrate that money spent on conservation is a sound investment. A conservation plan suited to the capabilities of the land and to the abilities of the owner and operator increased farm income in each area studied.

Conservation improves production, earnings, and farm family living level. Erosion and depletion strike a farmer first and through him reduce spendable income, the tax base and total area revenue. Erosion and depletion affect schools, churches, merchants, and the community; hence, all have a stake in soil and water conservation. Conservation of soil, water, and other renewable resources is a practical means of insuring the increasing population of an abundance of food, fiber, shelter, and other needs in a healthy economy.

Economic studies definitely show that a farmer should not reduce his expenditures for soil and water conservation practices, including fertility improvements, particularly if he is not now operating at a high level of conservation practices on the land. The farmer with efficient, high-volume production from the resources at his disposal will deal most effectively with the cost-price squeeze.

Studies of gross and net returns, over both the short and long run, resulting from adoption of individual and groups of soil conservation practices show that conservation doesn't cost; it pays! A basic soil and water conservation plan will help to improve the outlook and earnings on any farm or ranch.

Summary

The material condition of men's lives can profoundly affect the spiritual. Science and technology must be the servant of man, not the master. Therefore, the forces operating to change the agricultural picture must not be permitted to develop without guidance.

Farmers and ranchers find that cooperating with nature, using land within its capabilities and treating it according to needs pays off.

Farmers alone cannot assume the total responsibility for conservation. Responsibility must rest on all people if the public wishes to achieve conservation of land and water. Conservation must be supported as a basic national policy just as defense, public health, education, roads, and other measures for the benefit of all.

With the forecast of a million new families in the United States each year for the next 20 years, the pressure on our resources will be intense. Wise conservation policies combined with the application of best known practices as determined by sound research will be required to provide the capital and goods needed for this enlarged population. The cost of raw materials, both from renewable and non-renewable resources, is likely to increase. Technological progress that will develop new and more efficient ways of managing renewable natural resources is vital, considering the future pressures for use of these resources.

The basic importance of land and water to the material and moral welfare of man makes conservation a "must." Soil and water are God-given heritages to all people. Man is merely the custodian and good stewardship is a sacred responsibility. The amount of conservation of soil, water and related renewable natural resources that we achieve will have a direct bearing on the future standards of living of the nation and the world. Our *Society,* through the active cooperation of all members, can contribute much toward this goal.

Field Analysis of Furrow Irrigation in Orchards

GABRIEL EPSTEIN

This paper describes a practical field method of analyzing and working out a set of recommendations for irrigating any particular field and crop by the furrow system. The analysis and recommendations are based on accepted soil moisture determination methods.

THE FURROW method is the most complex of the known methods of irrigation, because so many factors are beyond the control of the irrigator. However, a number of controllable factors are often ignored.

Many old irrigated fields need an evaluation and performance check. Large quantities of irrigation water may be saved in areas of short supply, and fields now considered uneconomic to irrigate can be returned to profitable operation.

Industry and business consider it good management to analyze in detail the components of certain operations. Such an analysis is then used to increase the efficiency of production, sales and distribution. Irrigation management lends itself to a similar approach. The components of irrigation management in a particular field are studied. These components include the amount of water available, the schedule of availability (and whether it is rigid or flexible), the type of soil and its intake rate, the length of run, the water deficiencies based on consumptive use, the area wetted and the efficiency of applying water (present and potential). These conditions are analyzed and recommendations, limited by practical considerations, are developed.

This irrigation management analysis is a summary of the results and the derived recommendations for an orange grove near Redlands, California, over the two-year period, 1956-1957. Results obtained on other groves corroborate the methods used on this one. The field analysis and evaluations were made by Soil Conservation Service technicians during both irrigation seasons.

Early in 1956 several southern California citrus groves were selected and studies conducted of the methods and efficiencies of irrigation in these groves. In 1957 the field studies were repeated on some of the groves, while studies on the remainder were discontinued and other groves chosen in their place to broaden the scope of the trials.

Detailed data are presented for the years 1956 and 1957 in figures 1 and 2, and tables 1 and 2, together with the methods used in making the analysis. The results of both years are summarized in table 3. The methods of analysis used were the same for both years.

Gabreil Epstein is work unit conservationist at Redlands, California. He graduated from the University of California and during his career in agriculture has spent 12 years in Israel.

Description of Conditions and Procedure

The orchard analyzed was a mature, 9-acre orange grove. It contained large, well-developed trees with about 10 per cent of orange tree interplants. The yield record has been good.

Additional descriptive factors:

Soil: Hanford sandy loam—a deep uniform soil
Bulk Density (Apparent Specific Gravity): 1.4
Field Capacity: 13.2 percent, or 2 inches per foot
Wilting percent: 2.8 percent, or 0.45 inches per foot
Tree spacing: 20 feet x 21 feet
Pipeline number: 4
Distance between pipelines: 160 feet
Number and width of furrows: Two, 30 inches wide (36 inches in 1957)
Irrigation grade: 1 percent
Management practices: Weed free non-tillage

The source of water was a well with a flow of 57 Southern California Miner's Inches[1] in 1956, and 53 in 1957. The water quality is good. Tree roots are well distributed as indicated by the moisture extraction pattern. The soil is somewhat compact near the surface, with a water intake rate averaging 0.3 inches per hour. Prior to 1956 irrigation water was applied at irregular intervals for a period of 24 to 48 hours in the furrows. In 1956 and 1957 irrigation water was applied when about 60 percent of the available moisture had been extracted from the root zone. The area wetted was 60 per cent of the total grove area in 1956 and 67 percent in 1957. The 30-inch furrows were located 8 to 8½ feet from center of tree to middle of furrow in 1956. In 1957 the furrows were widened to 36 inches and spaced 7½ to 8 feet from center of tree to middle of furrow.

Before starting the trials, an agreement was made that the grove would be irrigated when about 60 percent of the available moisture had been extracted from four feet of the root zone, provided the well was not in use on other land at the same time. This practice was adhered to closely throughout the irrigation seasons of 1956 and 1957.

Soil moisture determinations were made by the gravimetric method. Samples were taken to a depth of 4 feet, as closely before and after irrigations as practicable, and occasionally during the interim. These soil moisture measurements are indicated in figures 1 and 2. Some of the samplings showed a higher percentage of moisture

[1]Southern California Miner's Inch = 9 gallons per minute of flow or approximately ½ Acre Inch per acre in 24 hours.

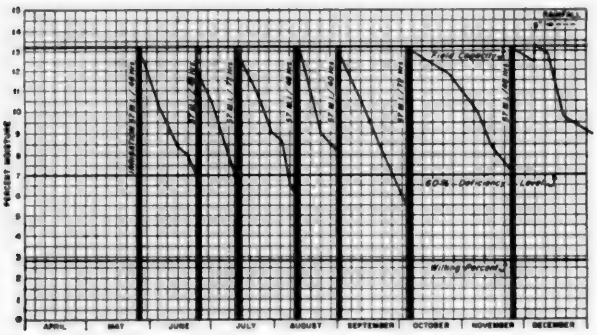

Figure 1. Soil moisture data on a 9 acre orange grove in Redlands, California, during the 1956 season.

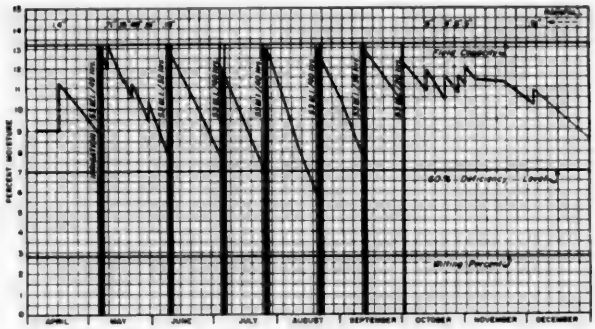

Figure 2. Soil moisture data on a 9 acre orange grove in Redlands, California, during the 1957 season.

than the field capacity (13.2 percent), especially in 1956 (figure 1). This was because samplings were taken too soon after irrigation. In 1957 this was corrected and a more reasonable figure for field capacity determined. The percent of moisture above field capacity is not given in figures 1 and 2 for the purpose of the data was to indicate extraction of water in the area below field capacity in the 4-foot zone. Moisture present in excess of field capacity was assumed lost through deep percolation and considered in the efficiency of irrigation in tables 1 and 2.

Observations and Explanation of Data

In 1956, 8 to 12 hours elapsed before water reached the furrow ends from the time it was turned into the furrows. This time interval was reduced to 3 to 4 hours in 1957. The greater number of hours used to achieve the same purpose in 1956 was because (1) furrows were circled around the young interplants through undisturbed soil with a higher intake rate than in the normal furrow locations, (2) the actual length of furrows was greater due to circling, and (3) the irrigator did not make any special effort to reduce the running time of the water. The total time water was kept in the furrows was 26 to 27 hours in 1956 and 19 to 20 hours in 1957. Thus, the ratio of time to reach furrows ends to the total running time in the furrows was 31 to 44 percent in 1956 and 16 to 20 percent in 1957. The size of furrow stream was 4.3 g.p.m. (gallons per minute) in 1956 and 4.0 g.p.m. in 1957. The average intake rate in this grove is about 2 g.p.m. per 100 feet of furrow. However, seasonal variations in the intake rate exist.

The above changes reduced the deep percolation around the young trees; it also reduced the percolation time at the upper end of the grove and the runoff at the lower end. (It is commonly accepted that the irrigation stream should reach the end of the furrow in about 25 percent of the total irrigating time.)

The data in tables 1 and 2, lines 1 to 7, record the conditions before and after each irrigation in 1956 and 1957. It is apparent the actual irrigation intervals were not too significantly different from the preferred intervals. However, the quantities of water applied to the wetted area of the grove during 1956 were greatly in excess of the deficiencies. This resulted in low efficiencies (25 to 45 percent). On the other hand, the replacement was generally good. In 1957, efficiency of irrigation was better than in 1956. This was because greater care was

Figure 3. Citrus grove in which irrigation study was conducted showing the two broad furrows used for irrigating.

Soil Conservation Service Photo by John Dean

Figure 4. Irrigation in progress in the citrus grove. Owner Robert Best (right) and author are observing water flow in the furrow.

Soil Conservation Service Photo by John Dean

exercised by the irrigator in handling the irrigation water and by adjusting the hours the well was operated to supply more nearly the required replacement. In 1957 the well averaged 9.5 hours operation for each inch of water replaced in the soil on the 9 acres at the rate of 477 gallons per minute. In 1956 the well averaged 13.5 hours operation for each inch of water replaced at the rate of 513 gallons per minute.

TABLE 1

Irrigation Management Analysis—Irrigation Season 1956—On a 9-Acre Orange Grove in Redlands, California

Item	*Unit*	*Months*							
		May	*June*	*July*	*August*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1. Actual Irrigation Interval	Days	29	19	29	21	34	51	—	
2. Preferred Irrigation Interval	Days	29	21	26	27	27	53	—	
3. Water Applied per Acre	Ac. In. Per Ac.	6.3	6.3	9.5	6.3	5.3	9.5	6.3	
4. Deficiency in Wetted Area (60%)	Inches		4.2	3.9	4.8	3.5	5.1	4.0	
5. Replaced in 60% of Area			3.1	3.9	4.7	3.5	5.1	4.0	
6. Efficiency of Irrigation	%		30	25	45	40	32	38	
7. Replacement	%		85	100	100	100	100	100	
Monthly Summary									
8. Consumptive Use in Area Wetted—(60%)	Inches	—	4.6	5.3	5.0	4.4	2.7	1.9	2.7
9. Required Replacement or Consumptive Use per Acre	Ac. In. Per Ac.	—	2.8	3.2	3.0	2.6	1.6	1.1	1.6
10. Water Applied per Acre	Ac. In. Per Ac.	1.1	7.3	10.2	9.9	4.7	5.7	5.5	4.9
Rainfall (approximately)									.5

TABLE 2

Irrigation Management Analysis—Irrigation Season 1957—On a 9-Acre Orange Grove in Redlands, California

Item	*Unit*	*Months*							
		May	*June*	*July*[1]	*August*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1. Actual Irrigation Interval	Days	34	26	24	27	20	—	—	
2. Preferred Irrigation Interval	Days	35	31	21	23	43	—	—	
3. Water Applied per Acre	Ac. In. Per Ac.	6.0	3.9	4.9	4.9	4.4	2.4	—	
4. Deficiency in Wetted Area (67%)	Inches	2.7	3.6	3.8	4.9	3.4	1.9	2.0	
5. Replacd in 67% of Area	Inches	2.7	3.6	3.5	4.6	3.4	1.3	—	
6. Efficiency of Irrigation	%	30	62	48	63	52	36	—	
7. Replacement	%	100	100	90	95	100	68	—	
Monthly Summary									
8. Consumptive Use in Area Wetted—(67%)	Inches	3.0	4.3	5.3	5.1	3.6	3.4	1.1	1.5
9. Required Replacement or Consumptive Use per Acre	Ac. In. Per Ac.	2.0	2.9	3.5	3.4	2.4	2.3	0.8	1.0
10. Water Applied per Acre	Ac. In. Per Ac.	4.6	4.7	6.6	6.0	6.6	1.1	—	—
Rainfall (approximately)	Inches	2.0	0.2	—	—	—	2.0	—	2.0

[1]Average 2 irrigations.

Descriptions of Items in Table 1 and Table 2

Line 1. The elapsed time, in days, from the start of one irrigation to the next. The elapsed time before the first irrigation of the season was estimated by extending the extraction curve to field capacity.

Line 2. This is the ideal interval between two specific irrigations. It is calculated by extending the extraction curve down to the point of its intersection with the 60 per cent deficiency line.

Line 3. Self explanatory.

Line 4. The difference between field capacity and the moisture per cent in the wetted area of the four foot root zone prior to irrigation, converted to inches.

Line 5. Inches of water replaced by irrigation in the wetted area of the root zone.

Line 6. The ratio of the replacement (line 5) to *applied water* (line 3) multiplied by the per cent of the area wetted.

Line 7. Direct ratio of the replacement (line 5) to the deficiency (line 4).

Lines 8, 9, and 10. Monthly summaries of the data shown in lines 1 to 7. In line 9, the required moisture replaced is adjusted from a wetted area to a per acre figure to provide a standard norm for comparison purposes.

In line 10, the applied water was pro-rated, e.g. Figure 1 shows that irrigations occurred on July 13, August 11, and September 1 in 1956. The amounts applied (from table 1) were 9.5 and 6.3 acre inches per acre in July and August. The intervals between irrigations were 29 and 21 days. The applied water for August was calculated as follows:

$$\frac{9.5}{29} \times 11 = 3.6$$

$$3.6 + 6.3 = 9.9 \text{ (table 1, line 10)}$$

TABLE 3
Irrigation Management Analysis Summary and Recommendations—1956 and 1957 Irrigation Seasons—On a 9-Acre Orange Grove in Redlands, California

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conditions	*Deficiency Replaced in Wetted Area*	*Wetted Area*	*Effic. Irrig.*	*Total Required per Acre* *Replacement*	*Acre Inches*	*Equiv. Miner's Inches*	*For No. Hrs.*	*Interval*	*Monthly Application Equivalent*
	Inches	*Percent*	*Percent*	*Percent*				*Days*	*Ac. In./Ac.*
Peak Use Season									
Actual 1956	3.9	60	33	95	7.0	12.6	27	23	9.0
Actual 1957	4.0	67	59	95	4.5	11.8	19	24	5.7
Recommended	4.2	70	70	100	4.2	11.8	17	25	5.0
Spring and Fall									
Actual 1956	4.2	60	36	100	6.9	12.6	26	38	5.4
Actual 1957	3.0	67	41	92	4.9	11.8	20	27	5.4
Recommended	4.2	70	70	100	4.2	11.8	17	38	3.3

Results Analyzed

Table 3 is a summary of the actual irrigation operations in 1956, the results of improvements made in 1957, and the recommendations made for future improvements.

Since the consumptive use per month varies, recommendations would necessarily have to vary accordingly. Furthermore, the climatic conditions would be expected to vary from year to year. Nevertheless, the specific data can be converted to use in a more general way in the field, provided the irrigator uses good judgment and checks his results occasionally.

The data obtained show that monthly consumptive uses for the period June, July and August, and possibly September, are not too far apart. This period can be termed the peak season. Hence, any recommendations based on average monthly figures for this period would be close. The same is true for the other months of the irrigation season, spring and fall, as a group. Thus, two distinct periods were considered in table 3, column 1, and recommendations were made accordingly.

Averages of known data, derived from tables 1 and 2, were used to reconstruct the actual conditions shown in table 3. The recommended conditions were constructed from the consumptive use averages (tables 1 and 2) and the infiltration rate, with the assumption that adjustments would be made in the duration and interval of irrigation depending upon the capability of the well.

When 60 percent of the moisture is extracted from the wetted area in this grove, the 4 foot root zone is deficient by 4.2 inches. This has to be replaced to bring the moisture to field capacity. The actual averages were derived from tables 1 and 2, line 5, according to the season. The actual wetted areas (table 3, col. 3) are known. The wetted area in this grove can be extended to 70 percent of the total area under good irrigating methods.

Average irrigation efficiencies (table 3, col. 4), and replacement (col. 5) were calculated from tables 1 and 2, lines 6 and 7. If efficiency can be raised to 70 percent, and 100 percent of the deficiency replaced at an irrigation (both within practical reach), then requirements per acre, and also the monthly application equivalent, will change as shown under "recommended" in table 3.

The acre inches required per acre (col. 6) were calculated according to the formula:

$$\frac{\textit{Deficiency Replaced (col. 2)} \times \textit{\% Wetted Area (col. 3)}}{\textit{Percent Irrigation Efficiency (col. 4)}}$$

The "actual" equivalent replacement (columns 7 and 8) in Southern California Miner's Inches and the number of hours the water was applied were taken from figures 1 and 2. The "recommended" figures were adjusted to the deficiency and the average furrow intake rate. *Example:* 4.2 acre inches per acre equal approximately 8.4 Southern California Miner's Inches running for 24 hours. The average intake rate in this grove is approximately 0.3 inch per hour. The required time for water to run in the furrow is therefore $4.2/0.3 = 14$ hours. Add 3 hours for water to reach the furrow end in a non-erosive stream[2], then 17 hours are required to irrigate any furrow when the above deficiency exists and the wetted area equals the efficiency.

The stream flow per acre is then determined as follows: 8.4 Miner's Inches for 24 hours equals 24/17 x 8.4, or 11.8 Miner's Inches for 17 hours. Since the well serving this grove now produces a flow of 53 Miner's Inches, approximately 4½ acres could be irrigated at one time. This would require two 17 hour sets for the 9-acre grove.

The "actual" averages for the irrigation interval in column 9 were derived from tables 1 and 2, line 1, according to season. The "recommended" intervals were calculated as follows:

$$\frac{\text{Inches Deficiency to be Replaced (table 3, col. 2)}}{\text{Average Monthly Consumptive Use in Wetted Area (tables 1 and 2, line 8)}} \times \text{No. days in mo.}$$

The "actual" figures for column 10 are seasonal averages from tables 1 and 2, line 10. To arrive at the "recommended" monthly application equivalent, the required

[2] *Methods for Evaluating Irrigation Systems*, Agricultural Handbook No. 82 by W. D. Criddle, S. Davis, C. H. Pair, & D. G. Shockley, issued April 1956 by the S.C.S., U.S.D.A., presents detailed guides in determining intake rates of soils, furrow spacing, maximum allowable furrow streams, and lengths of runs.

acre inches per acre (table 3, col. 6) are divided by the interval in days (table 3, col. 9) and multiplied by the number of days in a month.

Under improved irrigation methods described above, this grove would require a gross monthly application of about 5 acre inches per acre per month during the peak season and 3.3 acre inches per acre per month in the spring and fall. The interval between irrigations would be about 25 days during the peak season and 38 days in the spring and fall, depending on climatic conditions in any one year.

Thus, a specific guide has been developd for this particular grove and the irrigator may follow it with slight variations.

Summary and Conclusions

A method of analysis has been developed to evaluate existing conditions under which irrigation is practiced in a particular field. By this method, when inefficiencies in irrigation management exist, adjustments can be made to fulfill the irrigation requirements more efficiently. Other literature exists which deals with the nature of the changes needed and how they are implemented.

An orange grove was selected and determinations made of the consumptive use of water, the efficiency of irrigation, the duration of irrigation, and the intervals between irrigations during the 1956 and 1957 irrigation seasons. Analysis disclosed that under existing conditions irrigation efficiencies were low, water application was far in excess of the required replacement and the duration and intervals of irrigation were haphazardly decided.

During 1956, the seasonal application of water amounted to 49.3 acre inches per acre to replace a consumptive use of 15.9 acre inches per acre. In 1957 irrigation managment was changed and the seasonal application amounted to 29.6 acre inches per acre to replace 18.3 acre inches per acre of consumptive use. At the same time, the replacemnt of deficient moisture was very nearly 100 per cent.

The analysis indicated that further slight changes in management would bring the quantity of applied water closer to the water requirement. If this were done, assuming a seasonal consumptive use of 17 acre inches per acre, about 25 acre inches per acre of applied water would be needed. This would vary with the season, depending on climatic conditions.

This method of analysis may be applied with variations to any irrigated crop and field if the specific crop requirements, soil characteristics, climatic conditions, and irrigation water quality are considered. It is being used with moderate success on the irrigated land in Redlands, California. The method is intended for the use of those technicians experienced in the theory of irrigation and its practical application. The implications of the method as they affect any specific irrigated field can then be made clear to the practical irrigator.

Terracing in South Carolina

J. T McALISTER AND JAMES L. AULL

Terracing is almost as old as agriculture itself. More than 4,000 years ago the Incas were terracing steep hillsides. Modern terracing in South Carolina began in 1933, but for more than a century before that time South Carolina planters had used ditches and furrows across the slope to intercept runoff and retard erosion. This article traces the development of terracing in South Carolina from the first use of hillside ditches to present day terrace construction and use.

FIRST SETTLEMENTS in the Piedmont section of South Carolina were made between 1740 and 1760. That was prior to the invention of the cotton gin and only the river bottoms and flat lands were farmed. After 1800, cotton became an important crop, and sloping lands were cleared and planted. With little attention given to erosion control these sloping lands became severely eroded after a few years of continuous cotton cultivation.

The more progressive land owners of that day saw

J. T. McAlister (left) is conservation equipment engineer located at Orangeburg, South Carolina. He is a charter member of the Society.

James L. Aull (right) is State conservation engineer with the Soil Conservation Service in South Carolina.

Figure 1. Bench terraces can still be seen in the Piedmont section of South Carolina.

Soil Conservation Service Photo

the need for erosion control measures. First efforts were directed toward horizontal plowing as an attempt to keep farming operations on the contour. Hillside ditching, forerunner of the modern terrace, was then tried.

Hillside Ditches

Early construction of the hillside ditches was with shovel and hand labor. The ditches were "laid off" by eye and often had excessive grade. Some hillside ditch sections even had reverse grade. Specifications as to width of ditch, grade and distance between ditches varied with supposed requirements of climate and soil, or the fancy of the individual farmer. These hillside ditches were largely ineffective in controlling erosion. Eventually the practice was abandoned except where special care in lay-out and maintenance was followed.

Among the first of the Piedmont plantation owners to install a complete system of hillside ditches on his Fort Hill estate was John C. Calhoun, seventh vice-president of the United States and famous South Carolina statesman. The ditches on Fort Hill, now the home of Clemson Agricultural College, were carefully spaced and graded according to slope.

Bench Terraces

As cultivation of the steeper slopes continued, erosion progressed. More effective measures than hillside ditches were needed and efforts to correct their failures resulted in the development of bench terraces. Rocks, logs or other debris were placed in the broken hillside ditches and after a time, grass grew on this ditch spoil. Gradually firm banks were formed and subsequent tillage tended to develop level benches. Grades that had proved excessive were reduced and approached zero.

While bench terraces were an improvement over the hillside ditch for erosion control they did have several disadvantages. The natural slope of the land was changed and in so doing the soil profile was altered so that most of the topsoil was near the outer edge of the bench. On the steeper slopes there was a vertical drop between benches of as much as seven feet, making it impossible to move from one bench to the next without going to the ends where the slopes had not been benched.

Many of these bench terraces can still be seen in the Piedmont section of South Carolina, but they are seldom cultivated. Most of them are in grass or trees. These benches are difficult to farm and generally limited to one-mule equipment.

These early efforts to control erosion by earth barriers and slope alteration never seemed to provide for control of excess runoff and as development of bench terraces proceeded, efforts were made to make the bench level along its entire length. Excessive runoff would flow over the wall of the bench and start a gully which cut quickly into the bench. Even in recent years, line ditches were constructed at field or farm boundaries to provide for discharge of excess water down the slopes. These soon became large gullies if unprotected. Grassed or wooded areas nearby were used for discharge of excess runoff but silt clogged channels often prevented the discharged water from reaching these areas. Plowing methods which moved soil toward the field boundaries tended to develop areas higher than the other portions of the field.

This situation was appraised by a Mr. A. W. Venable

Figure 2. Constructing terraces in South Carolina during the 1930's.

of Brownsville, Virginia, writing "Hillside Ditches" in the February 1, 1938, issue of *The Farm Register*, published at Petersburg, Virginia. He wrote, "A bed should be thrown up by the plough 10 to 11 feet wide, graduated with sufficient fall to discharge the water, with a deep furrow on the upper side of the bed, leading to the first ravine, where there is a grass plot to receive the water and conduct it off."

Single Practice Not Adequate

Not long after cotton became the major crop in South Carolina, progressive plantation owners became aware of the serious threat of erosion through diminishing returns from their land. Control efforts that had been made were not promising and only a few farmers were practicing them. Most farming was done in straight rows regardless of topography. Erosion led to a considerable migration of farmers to states west of South Carolina prior to 1860. These pioneers were in search of new land —land less subject to erosion. Since most of those migrating were small farmers, owners of large plantations simply bought and also cleared more land as their fields became less fertile and more eroded.

About this time, however, attention was directed to vegetation as a means of erosion control. Rotations of row crops with grasses and legumes, as opposed to continuous cotton, were advocated. Numerous plants from northern States were tried, but were not well adapted to southern soils and climate. Bermuda grass was known to be well adapted and effective in erosion control, but in an area devoted to clean-cultivated crops it was considered a serious pest and was not widely used until recently.

Shortly after the establishment of Clemson Agricultural College, the South Carolina Agricultural Experiment Station directed the attention of farmers to the serious menace of erosion. Bulletin No. 32, published November 1897 and written by Professor J. S Newman, discussed the construction of bench terraces and hillside ditches along with the use of Bermuda grass in erosion control.

Figure 3. Vegetated terrace outlets are located and constructed to provide free flow of excess water from rows and terraces.

Figure 4. Farm equipment is the leading method of terrace construction in South Carolina.

Agricultural Extension work began in 1914. Through county agents, a more scientific approach was made to the layout and construction of a terrace system. Bulletins were prepared by the United States Department of Agriculture and several agricultural colleges outlining procedural details for establishing terrace systems. Shortly thereafter, Professor P. H Mangum of Wake Forest, North Carolina, developed a type of terrace that was widely accepted.

National Program of Erosion Control

An early publication on terracing states, "Terracing is the ultimate and most effective method of controlling erosion on cultivated fields."

Actually terraces do not completely stop the movement of soil. A terrace is simply a mechanical means of collecting that portion of rainfall the soil does not absorb and conducting it to a designated area where erosion is not a problem. It follows, therefore, that the extent and need for terraces is greatly influenced by the anticipated amount of runoff from a given area of land.

With this background of thinking, terracing work was begun by the Soil Erosion Service, forerunner of the Soil Conservation Service, on the South Tyger River Project in South Carolina in 1933. Terrace capacities were established by a calculated correlation between slope, soil type, and land use.

Slope fixed the vertical and horizontal interval of terraces, and velocity limited the grade. Use of a variable grade was practically standard procedure and very little attention was given to terrace alignment.

Outlets continued to be neglected in terracing systems. Natural drainage ways were disregarded, and outlets were usually placed as a matter of construction convenience instead of engineering design.

Soil Conservation Service Photo

Figure 5. Parallel terraces eliminate short rows and do not obstruct modern mechanized farming on this South Carolina farm.

The Nichols Terrace

The Nichols terrace was the prevalent type constructed in South Carolina with the inception of the National Program of Soil and Water Conservation. This terrace, with emphasis on the terrace channel, is built entirely from the upper side. Some farmers, however, preferred the Mangum terrace, with emphasis on the terrace ridge instead of the channel. A combination of these two types was widely adapted and seemed to prove satisfactory. The type of terrace constructed depended upon the equipment and the method used in construction. The variety of construction methods used resulted in a large variety of terrace types.

Terrace Built With Farm Power

Terrace construction is an earth moving job, and in the 1930's any farm power available, capable of moving earth, was utilized. Mule-power, farm tractors, patrols, and heavy graders pulled by crawler-type tractors served as earth movers. As mule-power is disappearing from South Carolina farms, it is no longer a significant terrace construction method.

Impovements in the versatility of farm equipment, the move toward more power and greater efficiency in tractor units, and the mechanization trend combine to make farm equipment the leading method of terrace construction in South Carolina. The patrol is again being used as a terrace construction tool and industrial earth moving equipment is beginning to enter this field.

Decline and Rise of Interest in Terracing

During World War II, and immediately thereafter a serious deterioration of terraces occurred in South Carolina. Not only did the number of miles of terraces constructed each year take a downward trend, but there was an alarming disregard by farmers in their field operations of those terraces previously constructed.

This situation was partially due to the extensive shift from row crops to grass which took place in the State after World War II. This land use change in many instances eliminated the need for terraces, however, this is not the total answer to the decline of interest in terracing.

A transition to mechanization, multiple-row equipment, and larger farms and fields has rendered obsolete the methods of planning and terrace layout used in the past. Such terraces are not adapted to the modern trend in farming practices and techniques. They constitute an interference with farming operations which is objectionable to the farmer.

Soil Conservation Service technicians assisting local Soil Conservation Districts in South Carolina have taken cognizance of these changes and are employing the following remedies: (1) Close attention to terrace alignment with grade adjustments (within safe limits) to improve alignment, (2) horizontal spacing of terraces in keeping with desired row widths and the use of multiple-row equipment, and (3) outlets in all natural drainage ways to reduce terrace length and to supplement row drainage.

Where topography is favorable, terraces are constructed parallel and short rows are eliminated. It is often practical to do a limited amount of land grading prior to terrace construction in order to produce a more uniform pattern of terrace and row alignment.

The techniques of terracing employed 20 years ago in South Carolina are as obsolete as the mule and drag pan with which many terraces were constructed at that time. For proper maintenance and enduring practice terraces must be adapted to the farming operation and the equipment used in that operation.

Modern farmers tolerate nothing that interferes with efficient farming operations. Terracing, as done 20 years ago, does interfere. Today the tide is turning. The improved alignment that is bing obtained should return terracing to its rightful place in a complete soil and water conservation program.

REFERENCES CITED

1. *Early Erosion Control Practices in Virginia.* U. S. Dept. of Agr., Misc. Pub. No. 256.

2. *The Story of Soil Conservation in the South Carolina Piedmont 1800-1860.* U. S. Dept. of Agr., Misc. Pub. No. 407.

Design of Small Dams. *By* BUREAU OF RECLAMATION, U. S. DEPT. OF INTERIOR. *611 pp., illus., refs., index, 1960. U S. Government Printing Office, Washington, D. C. $6.50 (Reviewed by* BRIAN M. REICH, *Fort Collins, Colorado.)*

Here is a book which has long been awaited by designers of small hydraulic structures. Its predecessor, *Low Dams*, now twenty years old and out of print, did not encompass the smaller works which are becoming so common in headwater areas. The new book listing 172 references brings together a large source of information in readily usable form besides recording the working practice and experience of a world renowned dam designing agency.

A short introductory chapter concerns "Project Planning." The second chapter, on "Flood Studies," discusses various methods and presents maps and charts for predicting the design storm by simplifying the triangular-component hydrograph presented in the Soil Conservation Service *National Engineering Handbook 4*. After briefly discussing "Selection of Type of Dam" consideration is given to "Foundations and Construction Materials." The book deals mainly with earth dams below a maximum height of fifty feet, although chapters are also included on "Rockfill Dams," and "Concrete Gravity Dams." Much attention is given to the use of airphotos, soil classification, rock type, and field and laboratory tests. Generalized sections of earth dams are presented with various dimensions of cutoff trenches, impervious zones, toe drains, etc., to suit particular conditions. Sectional details are given of about twenty small earthfill dams constructed over the last thirty years. A one hundred page chapter on "Spillways" presents many design charts and formula concerning the hydraulics of control structures, free-flow discharge channels, and terminal structures besides spillways themselves. The last two chapters deal with "Diversion During Construction" and "Maintenance and Operation."

Two hundred pages of appendices include 54 figures and 31 tables. They deal with the following subjects: "Estimating Rainfall Runoff from Soil and Cover Data," "Hydraulic Computations," "Structural Design Data," "Soil Mechanics Nomenclature," "Construction of Embankments," "Concrete in Construction," and "Sample Specifications."

This book forms an invaluable manual for the designers of water utilization, flood and sediment control structures.

New Water for a Thirsty World. *By* MICHAEL SALZMAN. *210 pp., refs., index, 1960. Science Foundation Press, Los Angeles 3, California. $5.95. (Reviewed by* JOHN B. STALL, *Urbana, Illinois.)*

This book is a sales promotion piece for the idea that large supplies of cool, potable water flowing in fissures in the deep-seated solid rock of the earth can be located from the surface and economically intercepted by drilling. This "new water" or "primary water" is supposedly formed under vast pressure by the combination of hydrogen and oxygen dissolved in the rock itself. As such, it supposedly has a different origin than "juvenile water," the highly mineralized, hot water deep in the earth which sometimes escapes, as from a volcano. Drilling sites for the interception of this primary water can allegedly be located by a southern California miner named Stephan Riess.

Any scientist who reads this book will quickly recognize it as a sensational appeal based on: (1) a highly documented, uncorrelated and ponderous series of textbook quotations, and (2) undocumented claims of success in the location of water.

The 181-page text is documented with 198 references, mostly to theoretical textbooks on rock formation and the physics of the earth, in a grasping attempt by the author to support the idea that these waters are actually formed deep in the primary rocks of the earth and can be tapped by drilling. Chapters V and VI called "The Dynamic Earth," which comprise a third of the book are the most dreary; they consist of uncorrelated citations of physical facts. The book is not an objective dissertation on a technical subject, it is a mimic of such. The large number of references is a facade erected to hide the lack of physical evidence. The sales approach is based on the sensational type of appeal, and banks heavily on the reader's lack of knowledge. The result is to put the scientific reader further on his guard.

Several success stories are cited regarding the drilling of primary water wells where reportedly other well drilling methods have failed. None of these cases is documented by other than uncorroborated newspaper stories. Because of the author's obvious bias the actual results of these cases cannot be determined.

No proof is given that the origin of this "primary water" is other than that of all water, precipitation. Locating the sources of this water is as much a mystery after reading the book as before.

Teaching Science Through Conservation. *By* MARTHA E. MENZER AND PAUL F. BRANDWINE. *470 pp., illus., app., refs., index, 1960. McGraw-Hill Book Co., 330 West Forty-second St., New York 36, N. Y. $7.50. (Reviewed by* BERNARD FRANK, *Fort Collins, Colorado.)*

Fairfield Osborne's Foreword states "Because conservation is so pervasive a subject, it must inevitably deal with human resources as well as with natural resources. . . ." Any adequate treatment of human resources must inescapably consider the interrelationships among people and the impacts of religious beliefs, political outlooks, economic interests, etc., on those interrelationships. The authors of this book themselves make clear "that resource problems cannot be solved by science alone," and that "economics, government, politics, and social institutions all play exceedingly important roles, even when science and technology have made their full and necessary contribution" (page 4). Judged by these criteria, the book does not cover the scope of conservation even in an introductory sense.

Nevertheless it does serve an essential, if limited, function in a field of human endeavor where considerations of the fundamental physical and biological processes have often been dominated by uncritical and emotional assertions. Any work that successfully takes so pervasive a subject out of the realm of unqualified or unsubstantiated assertions or unchallengeable dicta from the "highest authorities" by focusing attention on critical thinking through scientific observation and experiment, has met the foremost test of suitability for classroom instruction. If a text can also promote the student's natural curiosity by relating the subject to his daily recognizable experience with the physical world about him, it has met a second basic requirement for developing fertile young minds. These two requirements Munzer and Brandwine, both capable and experienced physical science educators, satisfy with distinction.

Teaching Science Through Conservation is designed to provide instructors with effective ideas and techniques for illustrating their respective topics with examples from the field of conservation. Thus, Part Two (seven chapters), "Conservation as a Study of Interrelationships Between Living Things and Their Environment," outlines easily constructed and often fascinating experiments which reveal the place of soil, water, plants and their organisms, the effects of changing the quality of the environment, and the opportunities for manipulating habitat factors to achieve certain conservation objectives. Similarly, Part Three (seven chapters) "Conservation as a Study of Interrelationships Between Matter and Energy," describes many simple ways of ascertaining the nature, behavior and effects of manipulating matter and energy in different forms.

The one much too brief chapter which comprises all of Part Four, "Our Future Resource Discoverers and Developers," is in some ways the most intriguing section of the book because it concerns the formidable problem of determining the aptitudes and arousing the interests of both student and teacher. It is here that professional conservationists can render material assistance by participating in lectures, demonstrations or training seminars, advising on career opportunities, and describing a few of the economic and social factors that sometimes abet, sometimes impede, the applications of science to conservation.

Altogether, the authors' thorough coverage of resources as an integrated whole, their clear presentation of the scientific basis for conservation, their dichotomous arrangement of the contents by interrelationships and subject areas to facilitate ready reference, and their ingenious array of teaching aids result in building an admirable tool for high school natural science courses.

Land, Wood and Water. *By* SENATOR ROBERT S. KERR. *380 pp., illus., refs., index, 1960. Fleet Publishing Corporation, 230 Park Avenue, New York 17, N. Y. $4.95.*

This popular-styled, lucidly written work by one of the Nation's public leaders in conservation presents in interesting manner some of the history and a bit of the philosophy of the conservation of water, forests and soils.

Senator Kerr, Chairman of the Senate Select Committee on Natural Water Resources, has drawn upon the efforts of his excellent staff and upon the 32 prints this committee has published for a basic portion of the book. Because of the author's interests, water is the resource discussed most thoroughly in the text. Senator Kerr's plan for development of river basins is presented in one chapter along with current legislative achievements. Policies to help solve some of the Nation's water resource problems will be presented by the select committee to Congress in January 1961.

The book touches upon many phases of conservation, but particularly covers the comprehensive development of river basins and contains a sizable section on irrigation. A section on "Pioneers in Conservation" biographically and with human interest sidelights sketches the careers of certain men. An entire chapter is devoted to Henry Garland Bennett's efforts in conservation.

The book does present with clarity important background information concerning water resource problems and some possible solutions to these problems. It could well be used by conservationists in the field for oral review before community groups to help them gain a good understanding of the Nation's water problems.

Current Literature Briefs

Proceedings—First Intersociety Conference on Irrigation and Drainage. By a group of twenty different men, each contributing with a separate article. 134 pp., illus. Published at Denver, Colorado, 1959. U. S. National Committee, International Commission on Irrigation and Drainage, P. O. Box 7826, Denver 15, Colorado. Price: $4.50.

This report is a collection of 26 papers presented at the First Intersociety Conference on Irrigation and Drainage held in San Francisco, California. The Conference theme was *"Can Man Develop a Permanent Irrigation Agriculture?"*

The speakers agreed that man can develop a permanent irrigation agriculture provided he acquires a thorough knowledge of his environment and uses this knowledge wisely. The papers tell what man now knows of the problems of irrigation agriculture and some ways many of these problems can be solved.

Preliminary Economic Considerations of the Arizona Watershed Program, Proceedings of the Second Annual Meeting. 77 pp., illus. 1958. State Land Department, Watershed Management Division, 431 Arizona State Office Building, Phoenix, Arizona.

Seventeen papers, each by a leading authority, make up this report. The first section consists of ten papers that deal with the economic aspects of water resource programs now in progress in Arizona. Section two contains five papers that generally relate to the management of forest lands. The last two papers deal with cooperative financing of watershed programs in California and similar possibilities in Arizona.

Soil and Water Use in the Soviet Union. Report of a Technical Study Group. 50 pp., illlus. 1959. U. S. Government Printing Office, Washington 25, D. C.

A Technical Study Group on Soil and Water Conservation visited the Soviet Union in 1958 to become acquainted with soil and water conservation work being done in the U.S.S.R. The group, consisting of seven men, was headed by Charles E. Kellogg of the Soil Conservation Service, U. S. Department of Agriculture.

The purposes of the study group were to become acquainted with (a) work being done in Russia in achieving balance between basic and applied research within the field of soil management, (b) work done at the field experiment stations and laboratories, (c) the use of soil maps in planning for and assistance to collective and state farms in their soil and water management, and (d) methods by which collective and state farms were given information about improved techniques of soil and water management.

Some of the more important areas of interest covered by the study group include soil conservation plans on farms, shelterbelts, soil erosion and soil blowing, irrigation farming, fertilizers, crop rotations, soil classification and soil maps and others. Generally, the report provides an extremely interesting and comprehensive picture of soil and water conservation in the Soviet Union.

Survey of Pittman-Robertson Activities. 1959. 64 pp. Fish and Wildlife Circular No. 82, Branch of Federal Aid, Bureau of Sport Fisheries and Wildlife, U. S. Department of Interior, Washington, D C.

The purpose of this publication is to keep members of the wildlife profession abreast of the research work being carried out under the Federal Aid in Wildlife Restoration Programs. Outstanding findings that come to light and new techniques that are developed are described. A list of publications written by Pittman-Robertson personnel during 1959 are listed.

Water Resources Reports and Data. Compiled by Cynthia Barnes, 77 pp., 1960, Water Resources Center, University of California, Berkeley, California.

A compilation listing titles and data to be found at headquarters of Los Angeles County Flood Control District, 2250 Alcazar Street, Los Angeles, California. The material listed represents work done by or for the district since 1915.

Natural Resource Use in Our Economy. William H. Stead, rev. ed. 1960, 88 pp., Joint Council on Economic Education, 2 West 46th Street, New York, N. Y. $1.25 single copy. $1.00 a copy for 10 or more.

Includes study and teaching aids for junior and senior high schools by George L. Fersh.

Central States Forest Experiment Station 1959 Annual Report. 96 pp., ill., USDA, Forest Service, Central States Experiment Station, Columbus, Ohio.

"An excellent introduction to water resources." —Journal of Soil and Water Conservation

WATER FACTS FOR THE NATION'S FUTURE

Walter B. Langbein, U. S. Geological Survey; and William G. Hoyt, formerly U. S. Department of the Interior.

Timely book offers an authoritative study of federal and state hydrologic programs for collecting, interpreting, and publishing water data. Gives practical recommendations for expansion and improvement; outlines specific steps that must be taken; presents many suggestions for improving the design of hydrologic networks. *A Conservation Foundation Study. 1959. 283 pp.; 41 ills., tables.* $5

Also sponsored by The Conservation Foundation

Vegetation and Watershed Management, Colman	$ 7.50
The Flood Control Controversy, Leopold-Maddock	$ 5.00
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Wildlife in Alaska, Leopold-Darling	$ 3.00

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Roy E. Huffman, Montana State College

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AMERICA'S NATURAL RESOURCES

Edited by a Committee headed by Charles H. Callison, National Wildlife Federation

A factual survey of our natural resources, their interdependence, and conservation. Experts describe each major renewable resource, point out its importance, the dangers threatening it, and methods for preserving and using it most profitably. *"An excellent source book."*—Soil Conservation. *Edited for the Natural Resources Council of America. 1957. 211 pp.* $4

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Fellows and Honorary Members — 1960

The Soil Conservation Society of America annually selects individuals who have made outstanding contributions to advance the science of soil and water conservation. The Fellow degree is awarded to members professionally engaged in practicing, investigating, administering or teaching soil and water conservation and related natural resource conservation. The Honorary Member award is made to individuals on the basis of their superior contributions to soil and water conservation and related natural resource conservation without regard to their professions, occupations, or Society membership.

Fellows

John W. Barnard, *University Park, Maryland.* Chief, Conservation Needs Branch, Soil Conservation Service. Chairman, Department of Agriculture Committee for the National Inventory of Soil and Water Conservation Needs.

A native of West Virginia, Mr. Barnard is a graduate of West Virginia. He joined the Soil Conservation Service in 1935 and has served in West Virginia, Maryland, and in the former Northeastern Regional Office at Upper Darby, Pennsylvania.

His work on the Conservation Needs Inventory is of vital importance to the planning of conservation work for the next 25 years. He is a charter member of the *Soil Conservation Society of America.*

Barnard has been active in the William Penn, Old Line, and Washington, D. C., Chapters of *SCSA,* serving as an officer in two of them. His guidance and leadership have helped to build a strong Society in the Northeastern Region. Currently, he represents that region on the Council of the *SCSA.* He represents the Society on the Policy Committee for Scientific Agricultural Societies and serves this group on the Scientific Manpower Commission.

Ayers Brinser, *Boulder, Colorado.* Professor of Economics, University of Colorado.

Until recently Mr. Brinser was Lecturer in Resource Economics at the Harvard Forest and a member of the faculty at the Graduate School of Public Administration, Harvard University, from which he received A.B. and M.A. degrees.

His contributions to soil and water conservation have been outstanding and one of his early projects was the book *Our Use of the Land* published by Harpers in 1939. He served as a consultant for the National Resources Planning Board and wrote a study of land use in New England titled *Better Rural Living.* He has been a frequent contributor to several "popular" and technical publications, including the JOURNAL OF SOIL AND WATER CONSERVATION.

Many conservationists have benefited from attendance at the Land-Use and Conservation Seminar formerly conducted by him at Harvard. This seminar and his courses have now been transferred to the University of Colorado.

Brinser's current study on small watersheds is soon to be published by the Iowa State University Press. He has been active in his local soil conservation district, serving as its first chairman. He was also the first chairman of the Southern New England Chapter of *SCSA.*

C. W. Chapman, *Athens, Georgia.* State Conservationist, Soil Conservation Service.

As one of the foremost leaders in the field of soil and water conservation in the Southeast, Mr. Chapman has been engaged in conservation work since 1933. Since 1946 he has been a member of the *Soil Conservation Society of America.* He has actively worked for the Georgia Chapter and has sought ways and means to coordinate the work of the *Soil Conservation Society of America* and the Association of Southern Agricultural Workers.

Under his supervision Georgia has the largest percentage of land under basic conservation plans of any state in the nation. Fifty percent of her 29,762,203 acres is so planned.

Active in working with industry to secure their interest and assistance in conservation work, Chapman has also developed educational and exhibit material of note and assisted with the planning of the Fourth National Watershed Congress.

Through his leadership the Water Use and Conservation Association of Georgia was instrumental in getting the General Assembly of Georgia to pass the Acts creating the Georgia Water Resources Commission and the Georgia Water Quality Council.

Ernest L. Gambell, *Silver Spring, Maryland.* Deputy Director, Program Analysis Division, Agricultural Conservation Program Service.

A native of Tennessee, Mr. Gambell received his B.S. degree in Agriculture from the University of Tennessee. After serving two years with the Tennessee Extension Service coordinating their work with the Agricultural Adjustment Administration, he transferred to the Tennessee State Office of AAA.

Working primarily on the agricultural conservation program, Gambell held positions of increasing responsibility in the AAA and successor agencies. The significant local, regional, and national positions held continuously by him for 26 years are evidence of his deep interest in conservation work.

He has exerted leadership in advancing understanding of the relationship between physical, economic, and human phases of conservation problems. The improvement of conservation programs through greater understanding, and local, regional, and national planning have been his constant aim.

As an active member of the Washington Chapter of the *SCSA* since 1949, he has served as chairman on various committees and as a chapter officer. He was leader of the Washington Chapter, *SCSA* and the Range Society joint committee that developed the booklet "Conservation of Our Renewable Natural Resources" which will be used in the Washington, D. C., area schools.

Minott Silliman, Jr., *Kankakee, Illinois.* Area Conservationist, Soil Conservation Service.

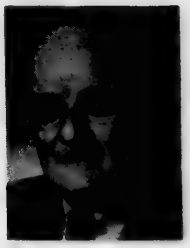
Mr. Silliman was born and reared on a purebred livestock farm in Illinois. Upon graduation from the University of Illinois, he worked in erosion control with the Forest Service and joined the Soil Conservation Service in 1935.

Serving in his present position since 1946, he has completed training courses in forestry, biology, and soils, and has taken a personnel management course at the University of Illinois. In 1959 he participated in seminars at the University of Illinois relating to industry and legal aspects of land use.

Harry A. Smallfield

Maurice K. Goddard

Arthur H. Richardson



Francis H. Kortright

J. Gilbert Cox

Silliman is a charter member of the *Soil Conservation Society of America*. He served on the Business and Organization Relations Committee during 1951 to 1955 and was a leading force in the development and distribution of "Down the River," first of the *Society's* popular type booklets that have sold in excess of three million copies. He has served on the *SCSA* Awards and Finance Committee and as chairman and secretary of the Northern Illinois Chapter. He has a long record of service to the *Society* that includes current membership on the Council of *SCSA* where he represents the North Central Region.

Clyde Spry, *Des Moines, Iowa.* Secretary of Agriculture, State of Iowa.

Mr. Spry farmed for 30 years and was appointed by the governor as a farmer member of the first State Soil Conservation Committee. In 1943 he was appointed Assistant Secretary of Agriculture and served also as secretary of the State Soil Conservation Committee. He became Secretary of Agriculture in 1950 and has been elected for five consecutive terms.

He continues to serve as a member of the State Soil Conservation Committee and his 21 years of such service have meant much to the soil conservation districts in Iowa and other states.

Spry led in the move to obtain state appropriations for soil conservation districts and Iowa now appropriates $1,200,000 each biennium. As Secretary of Agriculture, a member of the State Soil Conservation Committee and a member of the State Executive Council, his guidance has helped to establish sound administrative procedures.

He is active in the Iowa Chapter *SCSA*, assisted in planning the new Society home and in 1955 served as chairman of the Society's resolutions committee.

Honorary Members

J. Gilbert Cox, *Elliston, Virginia.* Farmer-Businessman

Mr. Cox is known throughout the United States as a leader in the soil conservation district movement. He is a livestock farmer and businessman in southwest Virginia and a member of the Virginia Chapter *SCSA*. He is Chairman of the Skyline Soil Conservation District, a Vice-President of the National Association of Soil Conservation Districts and a civic leader in his home community.

He has served continuously as a soil conservation district supervisor since his election in 1948. Cox has regularly attended the annual meetings of the Soil Conservation Districts. His work to advance soil and water conservation has been outstanding.

J. W. Cornwall, *Fairfield, Washington.* Rancher.

One of the great champions of soil conservation in the Northwest United States, J. W. "Wes" Cornwall has developed a "rundown" 400 acre wheat ranch in the Palouse country of Eastern Washington into a 2,100 acre conservation show place. During the early 1930's he took the first steps to prevent erosion and correct the fertility problems on his land. In doing this he worked with representatives of the Extension and Soil Conservation Services. He assisted in organizing a soil conservation association in his community in 1936, and in 1939 played an important role in establishing soil conservation district legislation in Washington.

Cornwall helped organize the Latah-Rock Creek Soil Conservation District in his home community. He was named president of the Washington Association of Soil Conservation Districts in 1947 and has regularly attended the national meeting of this group. He is now chairman of the State Soil Conservation Committee, a director of the National Association of Soil Conservation Districts, and chairman of the Research Committee of the Washington Association of Soil Conservation Districts.

Maurice K. Goddard, *Harrisburg, Pennsylvania.* Secretary of the Pennsylvania Department of Forests and Waters.

A forester by profession, Mr. Goddard received his B.S. degree at the University of Maine and an M.S. degree at the University of California. He was awarded an honorary Doctor of Science degree from Waynesburg College, Waynesburg, Pennsylvania.

Prior to his appointment as Secretary of the Department of Forests and Waters in 1955, he served as Director of the School of Forestry at Pennsylvania State University. He serves also as Chairman of the State Forestry Commission, the Water and Power Resources Board, the Geographic Board, and the Inter-Departmental Committee on Natural Resources.

Goddard is president of the Navigation Commission of the Delaware River and is a member of the Commission on Inter-State Cooperation, the Sanitary Water Board and the Soil Conservation Commission. He serves as a member, or ex-officio member, of numerous other groups related to the natural resource field. His efforts in coordinating the work of many groups have materially advanced conservation work in Pennsylvania and other states.

He is a member of the Keystone Chapter of the *SCSA* and was keynote speaker at the *Society's* thirteenth annual meeting in Asheville, North Carolina.

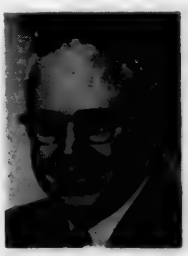
Francis H. Kortright, *Toronto, Ontario, Canada.* General Manager, A. R. Clarke and Company.

Among Canadians who have made an outstanding contribution in the field of conservation, the name of Mr. Kortright is prominent. For many years he has given unsparingly of his time, his energy, and a considerable amount of his money to further the conservation of Canada's renewable natural resources.

In 1948 he founded the Canadian National Sportsmen's Show, the largest show of its kind in North America. All profits from this show are devoted to conservation and to date more than $650,000 has been raised and spent for this purpose. Most of the money has been used to further the work of conservation organizations and support research projects at various universities. Neither Kortright nor his fellow directors receive any remuneration for their services on this project.

In 1952 he spearheaded the organization of the Conservation Council of Ontario. This Council has carried out major studies in the areas of water pollution, land use, forestry, soil and water, fish and wildlife, and conservation education. Findings and recommendations of the Conservation Council have frequently been incorporated into government policy.

C. W. McManamy



J. W. Cornwall

The American Ornithologists Union awarded him the coveted Brewster Memorial Medal for his book, *Ducks, Geese and Swans of North America*, now in its eighth edition. All royalties from the sale of this book are turned over by him to the Wildlife Management Institute.

C. W. McManamy, *Council Bluffs, Iowa.* Associate Editor, *Council Bluffs Nonpareil.*

Mr. McManamy was born in South Dakota and reared on a farm. He attended the University of Omaha and took advanced work at the Iowa State University and the University of Nebraska. During his service as Youth Director for the Extension Service in West Pottawattamie County, Iowa, he assisted with the organization of the county soil conservation district.

In 1947 he was named farm editor for Radio Station KSWI and wrote a daily column for the *Council Bluffs Nonpareil*. He was appointed farm editor of this newspaper in 1948, a position he held until he assumed his present assignment in May, 1960.

His daily column "Southwest Iowa Scene" has brought soil and water conservation to the attention of readers in western Iowa and parts of Kansas, Nebraska, and Missouri. McNanamy has served as speaker and toastmaster at hundreds of soil conservation meetings. Through the years he has regularly attended state and national meetings of the National Association of Soil Conservation Districts. Recently he purchased an 85 acre farm on which he resides. This land is protected from erosion by terraces, waterways, and grassland.

Arthur Herbert Richardson, *Toronto, Ontario, Canada.* Chief Conservation Engineer, Ontario Department of Planning and Development.

Mr. Richardson has made superior contributions to the organization and development of conservation programs in Ontario. It was largely through his vision and direction that the River Valley Conservation Authority movement began in 1944. He has been responsible for the growth and leadership of Conservation Authorities in Ontario. There are now 27 river valley conservation authorities embracing 17,550 square miles and involving 457 municipalities. Each authority receives technical direction from Richardson's office on studies relating to land use, water control, forestry, fish and wildlife, and recreation needs.

He is a graduate of McMaster University, received a Master of Silviculture degree from Harvard University and a Forest Engineer degree from the University of Toronto. He has been active in the Ontario Chapter of *SCSA* and has appeared on the program of the Society's annual meeting.

Harry A. Smallfield, *Guelph, Ontario, Canada.* Farmer.

Born at Renfrew, Ontario, Mr. Smallfield graduated from Ontario Agricultural College in 1921 and later received his M.S. degree from the Iowa State University. For more than 20 years he served on the staff of the Ontario Agricultural College in the Department of Dairy Science.

In 1942 he purchased a 150 acre farm near Guelph where he successfully developed a fine herd of Holstein cattle. He also established one of the earliest conservation planned farms in Ontario. His plans included contour strip cropping, drainage improvement, approved soil management procedures, and good crop production practices. The Smallfield farm has been looked upon as a model for conservation practices and has attracted thousands of visitors. Consequently, this farm has materially influenced the promotion of the soil conservation program throughout the Province of Ontario.

President's Citations and Commendation Awards 1960

Presidential Citations

Each year many individuals contribute immeasurable time, talent and treasure to further the objectives of the Soil Conservation Society of America. It is not possible to recognize each of these numerous persons who make the Society a vital force in conserving renewable natural resources. Therefore, it is the desire of the president to point out individuals who have made a singular contribution "to advance the science and art of good land use" and express his appreciation for their endeavors.

The ten individuals receiving the President's Citation in a ceremony at the Fifteenth Annual Meeting include:

Roy E. Ballard, *Tehachapi, California.* As a member of the California Chapter, he has secured more than 100 memberships during the past year. His enthusiasm and aid in organizing the Tehachapi Section of the California Chapter merits emulation.

Evan D. Bolton, *Nacogdoches, Texas.* His term as Council member resulted in his home state of Texas recording the largest *Society* membership increase for 1960. His excellent work is also reflected in the development of three additional chapters in Texas.

John R. Carreker, *Athens, Georgia.* He has served the Georgia Chapter diligently as Secretary-Treasurer and helped to secure *Society* sponsorship of the Conservation Section of the Association of Southern Agricultural Workers.

Bruce B. Clark, *Savoy, Illinois.* He is a charter member and has long served the *Society* as chairman and member of chapter committees, and as a member of the National Archives Committee.

Robert M. Hanna, *New Brunswick, New Jersey.* As chairman of the Student Chapter Committee, he has been responsible for the organization of three student chapters and one student branch of the *Society* during 1960.

Herschel E. Hecker, *Lexington, Kentucky.* As chairman of the Nominations Committee, he has rendered valuable service to the *Society* during 1960. Contact with chapters, study of nomination and election procedures, and guidance given by him have been of the highest caliber.

Ben O. Osborn, *Washington, D. C.* He has served the *Society* with honor as chairman of the Editorial Board of the JOURNAL OF SOIL AND WATER CONSERVATION. His excellent service is reflected in the quality of the JOURNAL and its benefit to members.

N. R. Richards, *Guelph, Ontario.* As chairman of the Annual Meeting Program Committee and Council member of the *Society* representing the Canadian region, he has fulfilled his duty with honor to himself and reflected distinction to the *Society*.

L. R. Webber, *Guelph, Ontario.* As chairman of the Local Arrangements Committee for the Fifteenth Annual Meeting, he has secured the active support and cooperation of conservation interests throughout Canada.

Richard A. Wilcox, *Des Moines, Iowa.* As chairman of the Elections Committee for the past two years, he has efficiently handled the tedious task of ballot counting in the regular and special elections of the *Society*. His untold hours of service in planning and accurately carrying out election procedures are commendable.

Commendations

Within local, State or regional boundaries a great number of individuals perform exceptional service in behalf of the Soil Conservation Society of America. The Commendation Award is presented to individuals, nominated by a chapter or Council member, for superior contributions in advancing the science and art of good land use.

The Awards Committee reviews all nominations. A certificate bearing the reason for the commendation is presented the recipient.

Those eleven individuals receiving the Commendation Award in a ceremony at the Fifteenth Annual Meeting include:

Joe R. Adair, Jr., *Lexington, N. C.*

Ernest E. Behn, *Boone, Iowa.*

Frank W. Clayton, *Arlington, Virginia.*

Edwin G. Crocker, *Storm Lake, Iowa.*

David J. Doneen, *Oakesdale, Wash.*

William N. Fisher, *Hickory Corners, Michigan.*

Roy A. Grizzell, Jr., *Decatur, Georgia.*

Allen F. Kinnison, *Berkeley, California.*

Morlan W. Nelson, *Boise, Idaho.*

John Byron Stall, *Urbana, Illinois.*

Joseph A. Wagner, *Falls Church, Va.*

Journal Awards

This year the selection of outstanding articles in the JOURNAL OF SOIL AND WATER CONSERVATION *was made by member nomination directed to the Editorial Board. Articles originally published in the* JOURNAL *between July 1, 1957, and June 30, 1960, were eligible for awards.*

Five authors received JOURNAL *awards of certificates inscribed as follows at the Fifteenth Annual Meeting:*

"To **F. L. Duley** for the superior article entitled 'Stubble Mulching in the Great Plains' that brought together the results of research on this subject and summarized the conclusions in usable form."

"To **George A. Pavelis** and **John F. Timmons** for the superior article 'Linear Programming: A New Tool for Watershed Planning' that describes a promising new method of evaluating alternative plans for resource management in watersheds."

"To **J. W. Zeeow** and **P. J. Zwerman** for the superior article entitled 'Soil and Water Conservation by Regulation' that described policies that have enabled the Dutch people to provide the world with an example of effective soil and water conservation."

Chapter Awards

The Washington, D. C., Chapter of the *Soil Conservation Society of America* walked away with the Sweepstakes banner in the 1960 outstanding chapter activity contest.

Sweepstakes winner in the total chapter program activity contest was the Northern Illinois Chapter of *SCSA*.

Winning the top award among the Student Chapters of the *Society* was the Rutgers Student Chapter at Rutgers University New Brunswick, New Jersey.

Regional winners in the single chapter activity contest included the Minnesota Chapter (North Central) and the Mississippi Chapter (Southeast).

Total chapter activities contest award winners on the regional level were the West Virginia Chapter (Northeast), the Andrew Jackson Chapter in Tennessee (Southeast), the South Dakota Chapter (Great Plains), the Inland Empire Chapter of Washington and Idaho (Western). In addition to being such wonderful hosts for the 15th annual *SCSA* meeting the Ontario Chapter was also named as Canadian regional winner in the total chapter activities contest.

Annual Audit Reported by *SCSA* Treasurer Barrows

The finances of the *Soil Conservation Society of America* have been studied by several groups during the past few weeks. For the fiscal year closed on June 30, 1960, a complete audit of the financial condition of the *Society* was made by Peat, Marwick, Mitchell & Co., with offices in the Hubbell Building, Des Moines, Iowa.

A report by Treasurer, Howard F. Barrows, was made at the Fifteenth Annual Meeting of the *Society* in Canada. In addition, the Finance Committee, chairmaned by Minott Silliman, Jr., 929 South Myrtle, Kankakee, Illinois, reported to the Council.

The following statement of financial condition of the *Society* was extracted from the report prepared by the accounting firm:

Soil Conservation Society of America, Incorporated

Statement of Financial Condition June 30, 1960

ASSETS

Current assets:		
Cash on hand and in banks		$23,371.89
Accounts receivable—booklets and emblems		1,269.20
Inventory—booklets and emblems, at cost:		
On hand	$ 2,900.11	
Advances on publication cost	2,000.00	4,900.11
Prepaid expenses:		
Office supplies	2,059.67	
Pension trust agreement	1,126.14	
Unexpired insurance	240.95	3,426.76
Total current assets		32,967.96
Building fund		10,429.64
Sustaining membership fund		3,870.00
Equipment replacement fund		580.00
Development fund		502.94
Treasury bonds and notes, at cost or amortized cost		14,959.09
Office equipment	10,518.49	
Less allowance for depreciation	4,616.67	5,901.82
Deposit with United Air Lines, Inc.		425.00
Total assets		$69,636.45

LIABILITIES

Current liabilities:		
Accounts payable	$	922.82
Chapter booklet commisions payable		1,019.10
Withholding tax deduction		258.55
Chapter dues refundable		161.00
Dues to other funds		313.05
Accrued payroll taxes		109.41
Total current liabilities	$	2,783.93
Deferred membership dues		24,084.16
Membership equity:		
Restricted equity:		
Building fund		$10,429.64
Sustaining membership fund		3,870.00
Equipment replacement fund		580.00
Development fund		502.94
Unrestricted equity		27,385.78
Total liabilities		$69,636.45

A complete report of the accounting would prove too lengthy for reproduction, but the Finance Committee has extracted the following short statement of income and expenses:

Income		
Membership	$42,290.94	(62%)
Journal	11,758.58	(17%)
Booklet Profits	12,178.22	(18%)
Chapter Supplies	1,071.53	(1½%)
Annual Meeting	1,071.22	(1½%)
Total Operating Income	$68,370.49	
Expenses		
International Office	$40,305.38	(57%)
Journal	26,130.10	(36%)
Other	4,640.51	(7%)
Total Operating Expenses	$71,075.99	
Operating Loss	$ 2,705.50	
Interest	761.70	
Net Loss	$ 1,943.80	

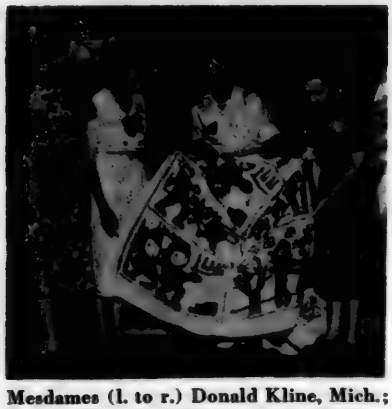
While the transactions for the year indicate a net loss, the yearly statement was formerly prepared on a cash basis whereas under the accrual system now used a total of $3,763.39, more than a year ago, was deferred from the collection of dues and credited against the new fiscal year that started on July 1, 1960. Had the *Society* been on a cash basis it would have been "in the black."

Net worth of the *Society* increased by $15,494.57 during the year with $10,429.64 coming from the building fund account. It is significant that the assets of the *Society* increased by $5,064.93 in addition to the new building fund account established during the year.

Questions may be referred to the accounting firm, the treasurer, the finance committee or the *Society* headquarters.

ANNUAL MEETING

The Andrew Jackson Chapter delegation from Tennessee proudly displays the banner won for their outstanding chapter program.



Mesdames (l. to r.) Donald Kline, Mich.; Muriel Christian, Mich.; L. R. Webber, Canada, and John Aycock, Tenn., admire a silk screen drapery design while on one of the ladies tours.

An attendance of 1,256, including women and children, was recorded at the 15th Annual Meeting of the *Society*, held on the beautiful campus of Ontario Agricultural College, Guelph, Ontario, Canada. Much credit for the excellent program sessions is due Prof. N. R. Richards and his Annual Meeting Program Committee.

An outstanding performance in handling local arrangements was in evidence at all times as a result of the meticulous planning of Prof. L. R. Webber and the Convention Arrangements Committee.

The North Carolina Chapter with 80 persons registered the largest attendance at the meeting, while the Michigan Chapter was not far behind with 79 individuals registered.

Hon. Alvin Hamilton, Minister of Northern Affairs and National Resources, Government of Canada (left) and Ontario Agricultural College President J. D. MacLachlan were among the outstanding platform speakers.

W. C. Gumbel

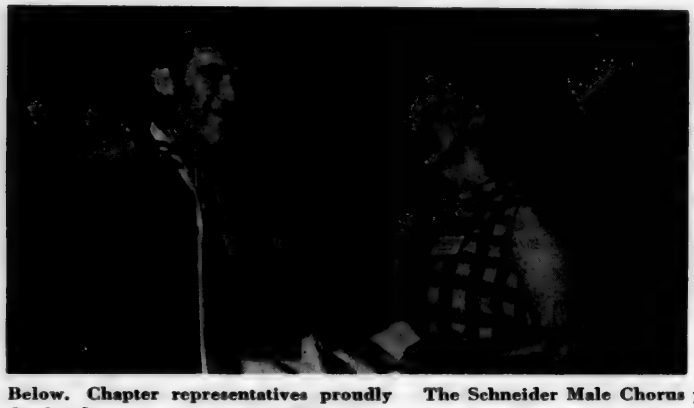
E. D. Bolton

SCSA Officers Elected

The largest number of ballots ever cast in a *Society* election were tabulated on August 8, and the results were announced at the meeting.

Walter C. Gumbel, Fairmont, West Virginia, was named as president of the *Society* for 1961. He is conservationist for the Monongahela Power Company and a graduate of Pennsylvania State University. Gumbel's active career in conservation includes service as Resources Consultant for the West Virginia Legislature, member of the State Soil Conservation Committee, chairman of the Committee on Water Resources of the West Virginia Chamber of Commerce, member of the American Water Works Association, member of the Conservation Committee of the National Association of Manufacturers, member of Northeastern Forest Research Advisory Board, and activity in many other groups devoted to conservation.

Other individuals elected who will be new to the



N. R. Richards presents the president's wife, Mrs. E. L. Sauer, with a gift.

Below. Chapter representatives proudly display banners won in the SCSA Chapter Activities Contest.

The Schneider Male Chorus presented a delightful program of semi-classical and popular music on Monday evening.

PHOTO RECORD

G. M. Browning

D. J. Sacco

1961 Council include Evan D. Bolton, Area Conservationist, SCS, Nacogdoches, Texas, who will be serving a three year term as Council member-at-large. George M. Browning, Associate Director of the Iowa Agricultural Experiment Station, Ames, Iowa, will serve a 1-year term as second vice-president. D. Joseph Sacco, Soil Conservation Service work unit conservationist, Sunbury, Pennsylvania, will serve a 3-year term as Council member for the Northeast Region.

Roy D. Hockensmith, Director of Soil Survey Operations for SCS, Washington, D. C., was named as first vice-president, after having completed a 1-year term as second vice-president. Minnott Silliman, Jr., area conservationist, SCS, Kankakee, Illinois, was reelected to a 3-year term as Council member from the North Central Region. Howard F. Barrows, St. Augustine, Florida, will again serve as Society Treasurer, a post he has held for the past six years.

President Sauer (behind banner) wishes the North Carolina group a safe homeward journey just before they "load up."

It was noted that a number of amateur photographers were taking 35mm. color shots of many interesting and informative scenes during their sojourn in Guelph. Would it not be well for *SCSA* to have a rather complete set of colored slides taken there?

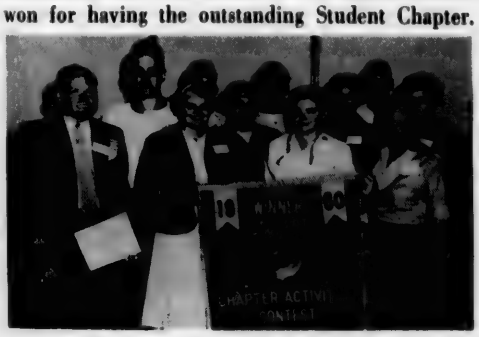
To implement this idea it is suggested that anyone having 35mm. colored slides taken during the 15th Annual Meeting or taken in Ontario, send them to the Editor, JOURNAL OF SOIL AND WATER CONSERVATION, 838 Fifth Avenue, Des Moines 14, Iowa. They should be sent prior to November 1. Copies of those that could be used will be made and all original slides sent will be returned by December 15, 1960. Be certain that each slide is identified!

A group of future conservationists demonstrate their ability to stow away quantities of present agricultural production at the outdoor barbecue on Tuesday evening.

Walter Gumbel (left) discusses Canadian road map with L. R. Webber (center) and Hugh Ayers.

SCSA President, Elmer Sauer holds a tobacco field conference with James Moredock, work unit conservationist, Alden, N. Y., while visiting the Doug Lillico tobacco farm near Brantford.

Members of the Rutgers Student Chapter, Rutgers University, New Brunswick, N. J., display banner won for having the outstanding Student Chapter.



Below. President Sauer gratefully accepts plaque presented SCSA by the Boy Scouts of America.

DATES TO REMEMBER

1960 Society of American Foresters Meeting. November 13-16. Washington, D. C.

National Farm-City Week. November 18-24. Throughout the Nation.

National Conference on Water Pollution. December 12-14. Washington, D. C.

American Association for the Advancement of Science, Symposium of Section O (Agriculture). December 27-30. New York City.

For further information concerning these meetings contact Society headquarters, 838 Fifth Ave., Des Moines 14, Iowa.

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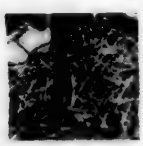

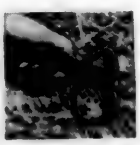

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IN MEMORIAM

J. Stuart Russell, farm editor, Des Moines Register and Tribune.

Conservation lost a devoted friend when J. Stuart (Jim or J. S.) Russell of Des Moines, Iowa, died in an auto accident on August 4.

He'll be long remembered for his tireless efforts in behalf of the *Society*. He served as treasurer for three years, as first vice president, and in 1957 as *Society* president.

He helped in countless others ways, as well. At the time of his death, he was chairman of the Housing Committee, and the tentative lease for a building site owned by Iowa State University was received the morning of his accident. He was also a member of the Development Fund Board.

Russell's devotion to conservation causes fit naturally with his 35 years as farm editor of the Des Moines Register and Tribune. Under his guidance, that newspaper sponsored the Register and Tribune Soil Conservation Achievement Awards Program.

Few saw more clearly the long time dependence of agriculture on conservation or worked more earnestly to unite the various individuals and groups which could help the conservation cause.

Russell's interests ranged throughout agriculture in its broadest sense. This led to numerous assignments outside his regular work. He served as deputy administrator of the Food Distribution Administration from 1942 to 1943 and as assistant to the War Food Administrator in Washington, D. C.

He was a director of the Federal Reserve Bank of Chicago from 1954 to 1959. He served as consultant to USDA, International Cooperation Administration and for the point four program (TCA).

In 1946, he was assistant to the chairman of the President's famine emergency committee. And in 1954 he toured Asia on a U. S. trade mission. World travel, plus a genuine love for people everywhere, made him feel keenly that America must share its abundance of food and technical knowledge with less fortunate peoples. His thinking and writing in this area stand as a worthy monument to America's pioneer newspaper farm editors.

Such action was typical of J. S. Russell, a man of warm understanding and a smile or word of encouragement for everyone he met. His death was a loss to all agriculture.

Mrs. Russell is at home at 620 Forty-eighth Street, Des Moines, Iowa.

—Alvin F. Bull

CHAPTER NEWS

Stillwater Chapter (Oklahoma) met July 15 for a picnic supper at the Stillwater Hydraulic Laboratory of the Agricultural Research Service. Demonstration of experiments on soil and water conservation structures provided the program. Member W. O. Ree, laboratory supervisor, assisted by W. R. Gwinn, hydraulic engineer, conducted flowing water tests on small models and also on a full size replica of pipe outlet spillways like those used in the agricultural flood prevention program.

Flow tests were also made on a model of a highway culvert being calibrated to serve as a runoff measuring station for hydrologic studies. The group also viewed the large experimental grassed waterways and the small unit channels which are currently being used to test the erosion potential of annuals. A short business meeting concluded the program.

Empire Chapter. Three summer meetings were held on a section basis featuring different small watersheds. They were spotted across the State enabling each chapter member to attend without traveling a great distance.

G. Claire Herting arranged the discussion and tour of the Great Brook Watershed, Chenango County, for the 40 persons attending. An evening dinner featuring a speaker from the New York Water Resources Commission rounded out the program.

Harold E. Klingaman made the preparations for a visit to the Little Hoosic Watershed, Rensselaer County. Ideal weather prevailed as 23 individuals observed work on the watershed and after a chicken dinner heard Dr. E. L. Cheatum, assistant director of the Fish and Game Division of New York, discuss "Integration of Conservation Programs."

Homer "Curly" Stennett, Empire Chapter membership chairman, made the arrangements for a tour on August 6 of the Conewango Watershed, Cattaraugus County.

Lake Cumberland Chapter (Kentucky) sponsored an interesting tour of the Bowaters Southern Paper Corporation's newsprint plant located at Calhoun, Tennessee. *SCSA* members from six Kentucky counties producing pulpwood were shown the process of converting pulpwood into newsprint.

Minnesota Chapter. The 2-day mid-June meeting featured a tour of the East Willow Creek Pilot Watershed and the Whitewater Valley area. School buses were used for transportation on the tour.

Dr. Melvin Wedul on the staff of Winona State College presented an excellent well-illustrated talk, "Conservation Workshops and School Camps."

First state-wide meeting of the nine SCSA chapters in Kansas was held at Hays, May 20-21. Highlighting the week of conservation activities was the declaration of the first Kansas soil conservation week by Governor Docking. Shown in the picture receiving the governor's proclamation are, left to right: Morrie A. Bolline, State Conservationist, Soil Conservation Service; Leslie C. Hunter, President, Kansas Association of Soil Conservation Districts; George Docking, Governor of Kansas; Howard M. Hughes, Chairman, Kansas State Council of Chapters, SCSA; Harold E. Jones, Director, Division of Extension, Kansas State University; Glenn H. Beck, Director, Kansas Agricultural Experiment Station.

Michigan Chapter. The July issue of the newsletter carries a summary of the "Soil and Water Conservation" contest sponsored by the Chapter for members of the Michigan Association of Future Farmers of America. W. S. Harrison, editor, Wells Hall, Michigan State College, East Lansing, may be able to supply correspondents with copies of this excellent issue.

Wisconsin Chapter. "The Development of Central Wisconsin Sandy Soils" was the theme of the summer meeting held at Hancock Branch Experiment Station.

Peter and Jeannie Jipson (9 and 11 years of age, respectively) are claimed by the chapter to be the youngest *Society* members in the Nation.

September 30 is the date for the Wisconsin Chapter's fall meeting to be held at Boscobel, centering on the theme "Tree Planting in Wisconsin."

Egyptian Chapter (Illinois) reports an interesting meeting held on June 10. John B. Stall's presentation "Water Resources of Illinois" was followed by a movie "Vision in Our Valley" which tells the story of the Muskingum Conservancy District in Ohio. Howard Mendenhall spoke briefly on the conservancy district law in Illinois after showing the film.

At a chapter meeting on September 9, William Herr was named chairman of the *Society's* Hugh Hammond Bennett Building fund drive. It was also announced that the chapter's winter meeting will be held December 9.

Stillwater Chapter members view a pipe outlet spillway model in a testing basin at the Stillwater Hydraulic Laboratory.

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Lane

McGinnies

Floyd E. Carlson, associate professor of forest extension at the State University of New York, is beginning a 2-year assignment in the Philippines. In cooperation with the University of the Philippines and ICA he will be working toward the development of a public education program in forestry in the Philippine Islands.

Triple recognition came recently to **John L. Schwendiman,** long-time *Society* member on the Soil Conservation Service staff at the Plant Materials Center, Pullman, Wash. He received the Inland Empire Chapter's 1959 award for outstanding work in conservation for developing superior grasses for use in the Northwest. A certificate of merit accompanied by a $200 check from the Soil Conservation Service was presented him for meritorious work. Then Northrup King and Company recognized him in the form of an honorary advertisement feature in several national magazines.

S. S. Pillai has moved from Calcutta, India, to Khartoum, Sudan, where he is now chief engineer in the Land Use and Rural Development Department of Sudan under the United Nations technical assisttance program.

Richard D. Lane became the Director of the Central States Forest Service Experiment Station in Columbus, Ohio, on August 1. He succeeds **Dr. William G. McGinnies,** Station Director for the past 6 years, who is retiring from the U. S. Forest Service after 30 years in research work. Mr. Lane will be responsible for Forest Service research in Illinois, Indiana, Iowa, Kentucky, Ohio and Missouri. This involves working with State research agencies and forest industries conducting research. Dr. McGinnies has been appointed coordinator of the University of Arizona's Arid Lands Project and Director of the Laboratory of Tree Ring Research. The Tree-Ring Laboratory is engaged in investigations correlating tree growth and weather. The Arid Lands Program is part of a world-wide project of UNESCO and is devoted to finding new and better ways to use arid land. This program is administered by the University and sponsored by the Rockefeller Foundation.

Nine *SCSA* members received superior service awards recently from the United States Department of Agriculture. Members honored by the Department included: **Franklin E. Allison,** ARS, Beltsville, Md.; **Wallace L. Bruce,** SCS, Sterling, Colo.; **Carl H. Dorny,** SCS, Washington, D. C.; **Frank H. Mendell,** SCS, Des Moines, Iowa; **Frederic G. Renner,** SCS, Washington, D. C.; **Marvin F. Schweers,** SCS, Madison, Wisc.; **Henry N. Smith,** SCS, Temple, Tex.; **J. Herbert Stone,** FS, Portland, Oreg.; **Herbert C. Storey,** FS, Washington, D. C.

The United States Department of Agriculture recently honored the Chamberlin Work Unit, SCS, Chamberlin, S. Dak., and the Hermiston Work Unit, SCS, Hermiston, Oreg., through presentation of superior service awards. **Lawrence J. Kehrwald** is work unit conservationist for the Chamberlin Unit and **Louis H. Parton** serves in similar capacity with the Hermiston Unit.

Floyd Heft represented the *Society* with merit at the Grasslands Council meeting held in Columbus, Ohio, during the summer.

Charles W. Mattison has retired from Government service after more than 40 years with the Forest Service. He has been serving as head of the the Education Branch of the Service's Division of Information and Education. Still a rugged forester he is now working part-time on a conservation education program for the American Forestry Association.

Melvin M. Thompson has assumed his new duties as area conservationist with the U. S. Soil Conservation Service headquartered in Fulton, Mo. He succeeds **John H. Gibson** who was transferred to Dayton, Ohio.

Stanley A. Cain, professor and chairman, Department of Conservation, University of Michigan, has been named to a six-year term on the Advisory Board on National Parks, Historic Sites, Buildings and Monuments by Secretary of the Interior Fred A. Seaton.

Four Texas members of the *Society* received certificates of merit and cash awards from the Soil Conservation Service in recognition of their outstanding work. They include: **William A. Gwin,** Wortham; **David N. Hand,** Corsicana; **Jack G. Douglas,** Amarillo; and **Charles A. Brooks,** Waxahachie.

(Continued on page 243)

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Now's the time to bury BERMIDRAIN® Pipe in your wet spots and lead it off to a dry well or ditch. BERMIDRAIN is the same famous BERMICO Black Bituminous Fibre pipe—scientifically perforated to collect and carry off water. It comes in light but strong easy-to-handle 8 ft. lengths, goes in fast and easy with snap-on couplings, no alignment problems—and inexpensive. It does not rust, rot, or corrode . . . unaffected by soil acids, thawing or freezing . . . lasts indefinitely.

Start Plowing Earlier . . . Stop "Drowning" Crops . . . Stop Slogging in Muck . . . Reduce Soil Erosion . . . Improve Land and Buildings.

For Wet Fields, Manure Dumping Areas, Exercise Yards, Building Foundations, Soil Conservation Programs.

See your Farm Supply or Building Materials dealer—or use coupon to ask for helpful information on drainage problems.

TRY KOWTOWLS®

Single-use, sanitary, udder-cleaning paper KOWTOWLS . . . used by thousands of dairy farmers to help control mastitis, reduce bacteria, produce cleaner milk, save time and labor. Free samples and literature.

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Watershed Development Series

1. From Plan to Profit

2. Partners

3. Stop Floods Before They Start

4. Small Watershed Program is paying off

Land Forming Series

5. Land Forming

6. Bargain Acres

7. Land Improvement

8. Farm Ponds

Range Development Series

9. Bring Back Your Range Grass

10. Revolt on the Great Plains

OUR GOAL
to help safeguard soil and water!

We all believe in, and practice conservation.

Conservationists – those dedicated men who devote their lives to conserving our nation's priceless assets of soil and water.

Caterpillar Dealers – share their know-how, provide equipment best suited for conservation, and encourage better land use.

Caterpillar – for more than 50 years we have worked with conservationists developing new techniques and equipment to serve the conservation field even better. We're proud to be a member of this team!

You have probably read our message on conserving soil and water, as told in major farm and consumer magazines – how conservation measures must be applied to a billion acres of land if we are to provide food, water, shelter and clothing for a booming population.

In addition, we are telling the conservation story to a select list of agriculturists; a few examples are illustrated at the left. Fill out the coupon below for free copies.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

CATERPILLAR

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Send me the items I've checked:

Water Development [1] [2] [3] [4]

Land Forming [5] [6] [7] [8]

Range Development [9] [10]

Name_____

Address_____

City_____ **State**_____

(Continued from page 241)

Serving on the Agricultural Hall of Fame Public Relations Committee is **Louis Wilson** of the American Plant Food Institute.

R. G. Downes, deputy director of the Victoria State Conservation Authority in Australia, is serving on a mission for the Food Agricultural Organization in Israel.

Alvin C. Watson, immediate past president of *SCSA*, represented the *Society* at the 1960 conference of the Conservation Education Association held August 15-18 in Oneonta, N. Y.

Kenneth Chalmers, state conservationist, was recently awarded an honorary State Farmer Degree by the Future Farmers of America at its Colorado State convention. **Russell Hill,** East Lansing, Mich., was similarly honored in Michigan earlier in the year.

William H. Kircher, Editor-in-Chief, "The Farmer" magazine, accepted on behalf of the magazine the 1960 Soil Management Award for Editors, presented each year by the National Plant Food Institute to magazines under 300,000 circulation. "The Farm Journal" magazine won the award for publications over 300,000 circulation.

Russell Neugebauer, Madison, Wisc., has been named as assistant conservation director for the National Wildlife Federation. He will be stationed in Washington, D. C., and among his duties will be direction of the annual National Wildlife Week observance.

C. Loyal Swanson, chief agronomist for Texaco, Inc., was recently elected to membership in the University of Illinois Chapter of Gamma Sigma Delta, an honor society in Agriculture.

William B. Oliver has been appointed as state conservationist for the Soil Conservation Service in Alaska. Succeeding him as state conservationist in Maine will be **Floyd W. Campbell, Jr.,** Burlington, Vt.

Belmont Pitkin has been appointed to the research staff of The Conservation Foundation. He recently completed 2 years of advanced study in conservation at the School of Natural Resources, University of Michigan.

The Niagara Soil Conservation District in New York offered to pay membership fees for all directors desiring to join the *Society* and the Empire State Chapter. All district directors are now *SCSA* members.

Philip Beauchamp recently started business for himself, general contracting in Reading, Massachusetts

"I BOUGHT THIS D6 USED. IT'S MAKING MONEY FOR ME!"

When a man goes into business for himself, he can't afford to take chances on his first machine, can he? As an operator, Philip Beauchamp was sold on Cat-built rigs, so he dropped in to see his Caterpillar Dealer. There he met a salesman who helped him with some friendly advice and showed him a fairly priced used "Bonded Buy" D6.

Actually, beyond his experience with Caterpillar equipment, the "Bonded Buy" guarantee influenced his decision. This is the safest buy in used equipment you can make anywhere. Exclusive on reconditioned Cat-built machines, it is a bonded guarantee—up to $10,000—of satisfactory machine performance and on *all* parts and labor during the guarantee period. Your Caterpillar Dealer, with his large selection of used equipment, also offers you two other types of protection—a "Certified Buy" and a "Buy and Try" deal on used units of any make.

Whether you're just beginning, middle size or a big contractor, you'll find as Philip Beauchamp did, you get your money's worth from your Caterpillar Dealer. He has a wide selection of reconditioned, classified and guaranteed trade-ins at fair, reasonable prices. He's interested in *your* needs and *your* problems and backs you with prompt service and parts you can trust. Don't buy "blind." See him—he's listed in the Yellow Pages.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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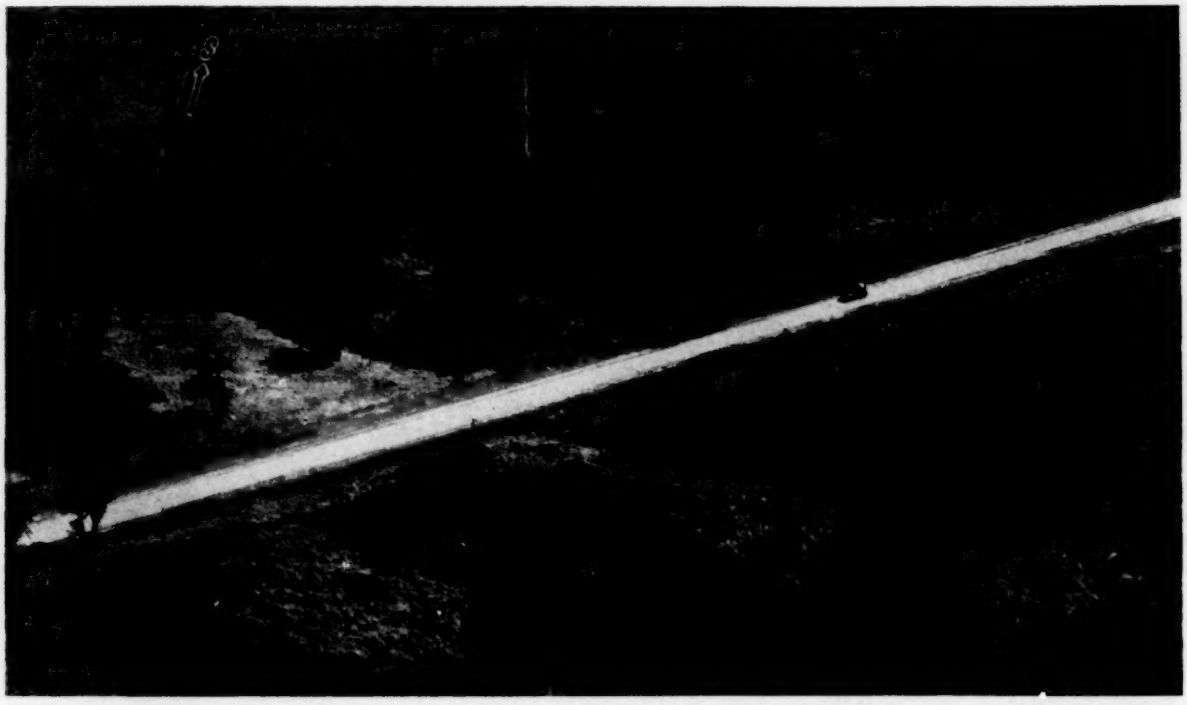
BEST BUYS IN NEW AND USED EQUIPMENT

ON WOODED GENTLY ROLLING SLOPES

A PERMANENT HOME FOR SCSA



Aerial view from the north of the proposed *SCSA* headquarters building site, the triangular 4.6 acre plot immediately above the highway with the pond in the center.

Final negotiations are now underway with the Iowa State University for leasing the site of the *SCSA* headquarters building. The lease, when approved, will run for 99 years at the nominal fee of $1.00 per year for the 4.6 acre lot.

The building site is located immediately north of Des Moines, Iowa, with easy access to the two new interstate highways passing through the city, thus allowing members traveling through an opportunity to stop and see their headquarters.

The 4.6 acre site was formerly a part of the 1,600 acre property, which during World War II housed an army ordnance plant and is now a part of the Iowa State University agricultural experiment farm system.

Looking south over the spring fed pool toward the building site. Plans place the structure immediately beyond the shadows across the pool. Note the thriving multiflora rose hedge along the back property line.

The Council, in action taken August 29, 1960, decided to erect in Des Moines, Iowa, in honor of the late Dr. H. H. Bennett the Hugh Hammond Bennett Building, designed to serve as the international headquarters of the *Soil Conservation Society of America*.

"Getting indoors out of the mists and storms accords with what needs to be done first." This statement in regard to the *Society's* building program, made by Dr. Bennett, vividly expresses the acute and present need for a permanent *SCSA* home.

Preliminary architect's sketches should be ready soon after November 1 for a building designed to meet the *Society's* needs for 15 to 25 years.

Examine closely the report on the facing page prepared by Harold M. "Dutch" Rhodes, chairman of the *Society's* Building Fund Committee. What action has your chapter taken? Have you made your pledge?

A report such as this will be made in each issue of the JOURNAL for the coming year. The site is now available. Together we shall, together we must, place the bricks for our *Society* home.

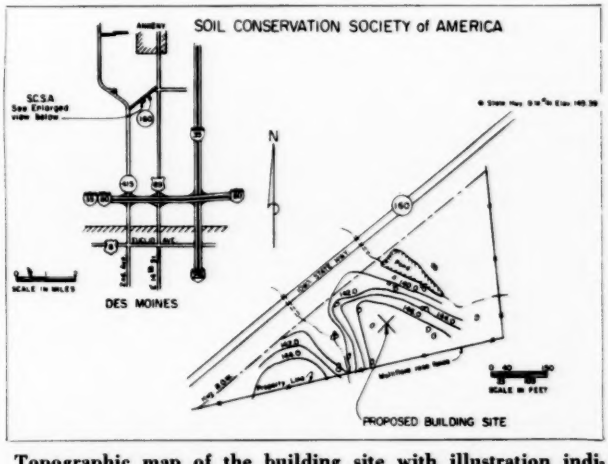
Building Fund Report—September 1, 1960

Chapter	Chapter Pledge	Individual Unpaid Pledges	Paid to Date	Other Evidence of Support
Washington, D. C.	$5,000	$2,790	$1,192	(2)
South Dakota		35	1,100	
Lincoln (*Nebr.*)			124	(1)
Salina (*Kans.*)			39	
Bozeman (*Mont.*)		20	37	
Wisconsin		16	259	(1) (2)
William Penn (*Del. & Pa.*)	400	40	118	
South Carolina		84	191	(1)
North Texas		8	82	(1)
Rio Grande (*N. Mex.*)			74.50	
Inland Empire (*Wash. & Idaho*)			128	
Empire State (*N. Y.*)	2,000	24	309	(2)
California		8	520	(2)
West Virginia	3,000	668	1,075	(2)
Pocomoke (*Md.*)			5	(2)
Keystone (*Pa.*)	1,000	16	53	
So. New England		24	58	(1)
New Jersey	1,250	28	699	(2)
N. E. Oklahoma			32	
El Paso Co. (*Colo.*)	250		30	
Michigan		310	283	(1) (2)
Ark River Bend (*Kans.*)			19	(1)
Hoosier (*Ind.*)			184	(1) (2)
Bluegrass (*Ky.*)		8	40	(2)
Virginia	2,500	60	418	(2)
Korea			20	(1)
Puerto Rico			30	
Florida		268	262	(1)
Utah		40	20	
N. W. Oklahoma			97	
Central Kentucky			5	
Arizona		16	80	
Georgia	5,000	28	131	(2)
North Carolina	5,000		282	(1)
Ft. Hays (*Kans.*)			10	
Green River (*Ky.*)			30	
S. W. Nebraska			14	
N. E. Oklahoma		8	22	
Mississippi		56	31	
Olympic View (*Wash.*)			14	
Lake Cumberland (*Ky.*)			5	
Ozark Mt. (*Ark.*)			15	
Custer (*N. Dak.*)			29	
Kentucky Lake (*Ky.*)			20	
Iowa	5,000		892	(2)
Manhattan (*Kans.*)		90	219	(2)
Ontario (*Canada*)			62	
Central Oklahoma		8	22	
Minnesota		109	149	(2)
S. C. Oklahoma			58	
S. C. Nebraska		8	103	
N. New England	1,480		45	(1)
Egyptian (*Ill.*)			32	
Red River Valley (*N. Dak. & Minn.*)		8	6	
Border (*N. Dak.*)			15	
Pony Express (*Kans.*)			41	
East Texas		73	49	(2)
Northern Illinois	2,600	484	288	(2)
Upper Kentucky River			40	(1)
North Alabama		20	12	
South Alabama			41	
Show Me (*Mo.*)			65	
All Ohio			156	(1)
E. C. Oklahoma			65	
Stillwater (*Okla.*)			56	
Idaho			123	(2)
Blue Stem Hills (*Kans.*)		24	14	
Wyoming		24	36	
Oregon		160	65	(1)
Andrew Jackson (*Tenn.*)	470	66	251	(2)
S. E. Oklahoma			14	
Big Hunt (*Okla.*)			13	
West Tennessee		8	77	(2)
Old Line (*Md.*)			341	
East Tennessee		8	35	(1) (2)
High Plains (*Kans.*)		8	42	
S. W. Oklahoma		8	2	
Louisiana			61	
N. E. Nebraska			27	
Heart of Texas		10	2	
Bob White (*Kans.*)			20	
Not Credited to a Chapter		80	255	
Total	**$34,950**	**$5,751**	**$11,980.50**	**33**

(1) General Chapter Support.

(2) Chapter Building Fund Committee Organized

HAVE YOU MADE YOUR PLEDGE?



Topographic map of the building site with illustration indicating relative position of the site to the two interstate highways near Des Moines.

Now . . . A Proven Way to Stabilize Critical Waterways

New S.C.S. Development Holds Soil in Place Until Vegetation Takes Over

By R. V. D. Broach
Soil Erosion Control Specialist
Ludlow Textile Products

Now you can put an end to seed and soil washouts by protecting waterway channels with Soil Saver — a heavy jute mesh that prevents erosion until grass or other vegetation is firmly established.

Soil Saver offers many advantages that make it the most practical aid yet developed for the establishment of turf in critical waterways.

Excellent Mulch

Soil Saver comes in easy-to-handle rolls, 50-and 75-yards long and four feet wide, with openings about 1" square. Pressed into the soil it provides over 3000 erosion "check-dams" per yard. Soil Saver's heavy jute strands provide an excellent uniform mulch, and add more than two tons of organic matter per acre. Because of its heavy open mesh construction, Soil Saver cannot be lifted by wind, water, or growing grass.

If you have seeded critical waterways, diversion terraces, spillways, drainage ditches, dikes or dams, again and again, only to see your top soil washed away by heavy rains, you can now seed these areas with complete confidence that the job will be final and effective.

Outstanding Results

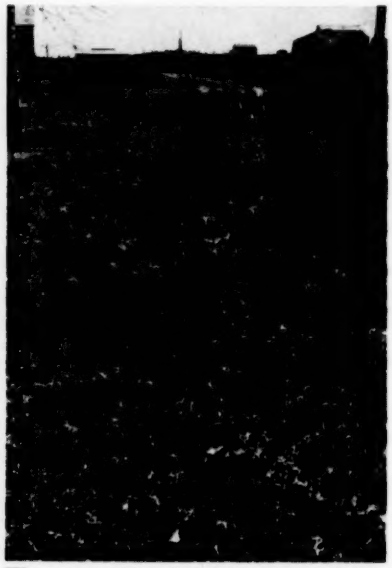
Soil Saver has been thoroughly tested by soil conservation groups for the past two years. It has made successful plantings possible on critical bankings and waterways where other erosion deterrents had failed. Many agronomists are agreed that seeding or sprigging with Soil Saver is the most practical method yet found for establishing vegetation in areas subjected to concentrated water flow. Now, because both terraces and outlets can be constructed *at the same time*, there is no need to temporarily divert water.

Once Soil Saver has been laid, there's nothing to do but wait for the grass to take hold. No maintenance is required. Soil Saver conforms to every accepted agronomic practice.

Send coupon today for free Soil Saver sample and complete installation directions.

Despite several attempts to grow erosion-resistant grasses, repeated washouts turned this Maryland farm waterway into a series of deep gullies.

After regrading and shaping, two widths of Soil Saver were laid to hold soil in place. Soil Saver kept heavy rain from washing out the channel before vegetation was established.



The same waterway is now completely stabilized with deep-rooted vegetation. By the time grasses take hold, Soil Saver has decomposed adding valuable humus to the soil. (S.C.S. Photos)

Ludlow

A Division of Ludlow Corporation

DEPT. 109

LUDLOW TEXTILE PRODUCTS
NEEDHAM HEIGHTS 94, MASS.

Please send me free Soil Saver sample and installation directions.
My particular problem is:.....
.....

Name.....*Title*.....
Route.....*Box*.....
Town.....
State.....